

Railway Mechanical Engineer

Volume 93

October, 1919

No. 10

CONTENTS

EDITORIALS:

An Educational Campaign Necessary.....	565
Limitations of Welding.....	565
Injustice to Stores Department.....	565
Is the Five Coupled Engine a Success?.....	566
Bad Order Car Situation.....	566
Wage Systems and Shop Efficiency.....	567
Some Neglected Recommendations.....	567

COMMUNICATIONS:

Inadequate Main Driving Boxes.....	568
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GENERAL:

Travelling Engineers' Convention.....	569
Front Ends, Grates and Ash Pans.....	576
Cast Iron Piston Rod Packing.....	577
Fire Proof Terminal Oil House.....	579
Railroad Administration News.....	581
Dirt in Coal.....	582
Santa Fe Type Locomotive for Light Track.....	583
Certain Essentials.....	584

CAR DEPARTMENT:

General Characteristics of Chinese Rolling Stock.....	585
Vacuum Brakes.....	586
Illumination of the Railway Car.....	587

Draft Gear Design and Maintenance.....	590
Car Inspectors and Foremen Meet.....	593
Bad Order Coal Car Situation.....	595
Modern Methods of Painting Cars.....	597

SHOP PRACTICE:

Large Oxy-Acetylene Weld in Pennsylvania Shops.....	599
Improved Key Block for Main Rods.....	600
Removing Liquids from Barrels.....	600
General Foremen's Convention.....	601
Convention of Master Painters.....	605
Washer Punching Dies.....	612
Autogenous Welding of Fireboxes.....	612
Railway Tool Foremen's Convention.....	613

NEW DEVICES:

The Plastic Arc Welding Outfit.....	617
The Fosdick Heavy Duty Upright Drill.....	617
The Multi-Cut Service Lathe.....	618
Newton Centering Machine.....	620

GENERAL NEWS:

Notes.....	621
Meetings and Conventions.....	623
Personal Mention.....	623
Supply Trade Notes.....	624
Catalogues.....	626

An Educational Campaign Necessary

A study made by employment experts indicates that a large percentage of the misunderstandings with labor in industrial organizations is due to the fact that foreigners do not appreciate the conditions under which they are working and the ideals which dominate American industrial establishments. A comparatively small amount of educational work along these lines in some establishments has been very helpful in promoting harmony and in eliminating possible sources of trouble. The seriousness of the alien problem is no more clearly indicated than by the steel strike. The American born workers are apparently against the strike and are loyal to their employers, while the foreign born, or aliens, are supporting the strike and are apparently entirely in the hands of the radical element. It is time that every railroad and every department on the railroad took careful steps to study its labor conditions and wherever necessary to introduce intensive educational work tending to completely Americanize all of its employees. Work along this line will certainly result in a more effective organization.

Limitations of Welding

The oxy-acetylene and electric welding processes have been found suitable for such a wide variety of work that some have gained the impression that autogenous welding can be used satisfactorily under practically any conditions. One large railroad recently had two wrecks due to the failure of welded parts, which illustrates the disastrous results that may follow if welding is not confined to its proper sphere. These wrecks occurred in an interval

of a few weeks and in both cases the cause was traced to a welded car axle. Appearances indicated that at some time brake rods or other parts had borne on the axle and had worn a groove around it. This depression had been filled by welding and the axle had been reapplied. Instead of strengthening the axle, the heat of the welding operation probably affected the structure of the metal, weakening it and resulting in failure under load. The damage caused by these two wrecks amounted to several thousand dollars and it is hardly necessary to point out that this would have been sufficient to pay for a considerable number of new axles.

The American Railroad Association Committee on Welding Truck Side Frames, Bolsters and Arch Bars has recommended that welding cracks or fractures should not be permitted on axles, arch bars, car wheels or tires, truck equalizers, spring or bolster hangers, brake wheels, coupler bodies or knuckles, knuckle pins, locks, lifters or throwers, or on parts made of alloy steel or heat treated carbon steel. Although the welding of these parts has not been officially prohibited by the association, the committee's report will almost certainly be adopted. At any rate, it would seem that roads that have made a practice of welding the parts named above might do well to follow the recommendations of the committee.

Injustice to Stores Department

The stores departments of the railroads have faced a most difficult situation during the past year or so. The men in this department have not been organized and for some reason the Railroad Administration has left the readjustment of wages and salaries to the regional authorities. The matter was finally attended to in some regions, but the employees in other regions have up to

this time had little, if any, consideration. Not only have the storekeepers themselves been discouraged because of lack of recognition in the revision of salaries, but they have had to struggle along as best they could with the payment of very low wages to their employees, as compared to the other departments alongside of which they have been working. This was quite forcefully brought out in the discussion of the paper which was presented at the September meeting of the New York Railroad Club by Director of Purchases Henry B. Spencer. Complaint was also made of the large amount of red tape which the storekeeping departments are having to observe in connection with the preparation of reports preliminary to the turning back of the railroads to their owners.

In the words of one of the speakers, the stores department could make good under the present conditions if it was required to provide only those things which were essential and could cut out the frills. In reply to this criticism, Frank McManamy, assistant director of operation, claimed that the ball of red tape was small as compared to that used on some of the railroads under former conditions. George G. Yeomans, the assistant director of purchases, stated that the requirements of the Railroad Administration were burdensome only to those roads which did not keep accurate records as to the amount of material on hand and where it was located. Regardless of these statements, however, the testimony of storekeepers generally is that the conditions under which they are now working are extremely difficult and burdensome and that some relief should be afforded, both in making suitable allowances for the wages and salaries of men in this department, as well as the elimination of all reports that are not absolutely essential.

**Is the Five
Coupled Engine
a Success?**

The progressive increase in the size of road engines has in recent years led to the adoption of the Santa Fe and Decapod types to replace the Consolidation and Mikado. Railroad officers have considered it axiomatic that as the tractive effort of locomotives increases the cost of wages for train and engine men and of locomotive repairs would decrease (on a ton-mile basis). So long as this holds good the adoption of heavy motive power would prove economical as the other two large items of expense, locomotive fuel and maintenance of way and structures, were only slightly affected by the size of the locomotives. Some statistics of the cost of maintenance of locomotives with five pairs of drivers which have recently been compiled indicate that there is some room for doubt as to whether the introduction of these locomotives has reduced the cost of transportation.

The cost of maintaining the machinery on Santa Fe and Decapod locomotives has been found to be disproportionately high. The wear on side rod bushings, back end main rod brasses and driving boxes is excessive. Tire wear in some cases amounts to as much as 1-16 in. per month, necessitating turning the tires every 20,000 miles. In some designs the boiler tubes have been placed too close together in the attempt to secure adequate heating surface, and this has made frequent tube renewals necessary. Where the roadbed has many curves, locomotives with five pairs of drivers have proved extremely hard on the track.

Against these disadvantages must be weighed the advantage of the heavier train load to be secured due to higher tractive effort. In this connection it is well to note that each successive increase of 10,000 lb. in the tractive effort causes a smaller reduction in the cost of wages for the train crew per gross ton mile. Furthermore, the cost of locomotive repairs and enginehouse expenses on a ton-mile basis is greater than the cost of wages for enginemen and

trainmen, therefore a decrease in the cost of wages may be more than offset by an increase in the cost of locomotive maintenance.

The Santa Fe and Decapod types have probably not been in service long enough to determine definitely under what conditions they can be operated more economically than the Mikado type. The data given above indicates that careful consideration is necessary to avoid costly mistakes in the selection of heavy motive power.

**Bad Order
Car
Situation**

With the approach of the winter season and its attending difficulties of transportation the freight car situation is a matter of concern not only to railroad men but to the people of the entire country. The condition of freight cars in general is of great moment, but the most vital question is whether or not we are to have efficient service in the distribution of fuel. In recent statements made before the Senate committee investigating the coal situation we find a wide divergence of opinion as to the probability of a coal shortage and the necessity of immediate attention being given to the repair of bad order cars, of which there are undoubtedly a great number—far too many. The coal producers insist that they are not supplied with coal cars in sufficient numbers to warrant the constant operation of the mines; that at many of the mines it has been necessary to suspend operations entirely for extended periods (285 mines were reported idle during the week of July 26) because of the car shortage.

The Railroad Administration, however, contends that there is no serious car shortage and that car repairs are being made as rapidly as conditions require. Recent statements by Railroad Administration officials indicate that for the purpose of keeping down expenditures the car repair program has been much curtailed in recent months and that this accounts in part for the increase in the number of bad order cars. The Railroad Administration claims to have the situation under control and that any coal shortage will not be due to lack of cars.

Whatever may be the merits of either side of this controversy it is a fact that the general condition of freight cars throughout the country is bad. Evidence of this may be seen at any terminal. The aspect of the bad order car situation is not very bright in view of the conditions existing during the last half of 1918 and the fact that the working hours of the shopmen have been very considerably reduced during 1919 the result of which can not have been other than to reduce the output of repairs.

The reports of the railroads to the Division of Operation of the Railroad Administration covering a period of 10 weeks from July 20 to September 21, 1918, show that while the number of cars requiring heavy repairs increased from 49 per cent to 59 per cent of the total number listed as in bad order, only about 10 per cent of the cars reported as turned out of shop during that time were given heavy repairs. This indicates that many cars requiring heavy repairs were given only sufficient attention to put them in such condition as would permit their use—in other words, they had been turned in for heavy repairs and were given only light repairs. This practice of putting off the evil day can not be too strongly condemned, as it inevitably leads to a generally poor condition of equipment and merely adds to the difficulty of eventually putting the cars in proper condition.

The steady increase in the percentage of cars requiring heavy repairs and the reduced output of the repair shops makes it highly improbable that the car repair situation is under control or in a very encouraging condition at the present time. For the purpose of keeping down expenditures the needed repairs have been neglected during the present

year and it is quite probable that since the opportunity to remedy the poor condition during a favorable season has passed, we can look for no great improvement now that the demands for cars will become greater, unless immediate and adequate steps are taken to remedy the bad order car situation.

It is the plain duty of those entrusted with the production and distribution of a necessity such as coal to leave nothing undone that might cause disruption of the service to which the consumer, who, of course, must pay the bills, is entitled. While the doctors disagree on the diagnosis the patient frequently dies of the disease. Have done with quibbling over the cause and apply the remedy.

Wage Systems and Shop Efficiency

At the present time there is a great deal of discussion concerning the relative cost of doing work on an hourly wage basis of payment and under special wage systems, such as piecework or bonus plans. Some contend that the abolition of piecework has reduced the shop output very greatly; others claim that operations can be performed quite as economically under the day work system if the supervisory force is properly organized. Whatever the ultimate effect may be, there is no question that some shops that have changed from piecework to day work are finding the readjustment to meet the new conditions very difficult.

Special wage systems have been likened to patent medicines that often proved remedies for many of the diseases of the shop system. They supplied an individual incentive for high production which counteracted the effects of inadequate supervision, lack of facilities and poor shop arrangement. The piecework system caused the men to plan their work to avoid delays as much as possible while the fixing of rates for various operations necessitated close attention to the details of the work, which disclosed wastes and led to their correction. In order to secure as good results from day work as were secured when piecework was in operation, some other agency must be supplied to effect the performance of these functions.

One of the handicaps which have often been overcome by piecework is a poor shop layout. When each man is interested in having work brought to his machine promptly the foreman is not called on to give much attention to the delivery of material, regardless of the defects in the arrangement of tools in the shop. Under a daywork system there is more need for a scientific layout and for co-operation with the workmen to eliminate wasted time. With the incentive for following up work removed, adequate crane or trucking service and means for furnishing the necessary tools and drawings without delay are essential.

Of even greater importance than the routing and distribution of work is the detailed study of shop operations and the establishment of definite standards to gage results. This could be followed out as well under day work as with piecework, but there is some question as to the feasibility of establishing such systems under present conditions. The labor organizations which are now the recognized representatives of the shop craftsmen have in the past opposed any detailed time studies of machine operations in any of the union shops.

The unions have maintained that time studies were only a means of exploiting the workers, while the railroad officers have interpreted the opposition as an attempt to decrease production and to shield inefficient workmen. Time studies, if rationally employed, would be of great benefit in improving shop operation and there is no inherent reason for opposition on the part of labor organizations. There seems to be leveling among the officers of the American Federation of

Labor a tendency to recognize the fact that high production is the only guarantee of prosperity for the workers. The position which this organization has assumed in the past may be considerably modified and the objections to detailed studies of shop operations may be abandoned. The matter has such an important bearing on shop costs that the future attitude of the federation will be watched with a great deal of interest.

Some Neglected Recommendations

During the past two months conventions were held by several of the mechanical associations which had not met since 1916. Among the most important action taken at these conventions was the renewal of recommendations made in previous years but not yet adopted by the railroads.

The Master Blacksmiths' Association brought out the benefits that could be derived by a standardization of certain details of safety appliances. At the present time brake staffs are made with drums of various diameters and lengths. The Safety Appliance Act forbids the welding of brake staffs, therefore, in case a broken brake staff cannot be duplicated from stock it must be forged by hand, which is an expensive process. A standard brake staff could readily be designed which would vary only as to length and a limited number of lengths could be adopted to meet the requirements of all ordinary types and sizes of freight cars now in service.

A like situation exists with regard to grab irons. The safety appliance standards mention four different lengths, namely 14 in., 16 in., 18 in. and 24 in. The roads, however, have not adhered to these dimensions and as the welding of grab irons is not permitted under the M. C. B. rules, it is often a difficult matter to replace one that is broken. If standard designs of each of the lengths given above were adopted, one type for application to the car body and another for use with wooden or metal stiles, these eight different sizes could be made to meet practically all of the requirements.

Definite action intended to bring about a standardization of small tools was taken at the convention of the Tool Foremen's Association. Many of the hand tools which are now made in railroad shops could be purchased at a saving if the manufacturers were able to meet the demands of all the railroads with a single design. Due to minor differences in the sizes of squares, or lengths and diameter of shanks, these tools are now classed as special material. Not only is the price considerably higher than for standard types but the time required to fill an order is also much longer. The makers of small tools would willingly co-operate with the railroads in establishing standards and it is to be hoped that the work begun in 1915 will now be carried to a successful conclusion.

Another matter which has awakened renewed interest is the purchase of paint and varnish on specifications, which was brought up at the convention of the Master Car and Locomotive Painters' Association. The immediate cause of the protest against specifications for these materials was the inferior quality of the paint furnished under the Administration's requirements. The shortage of linseed oil makes it almost necessary to accept substitutes, but this will not necessarily result in lowering the quality of the material as many of these substitute oils have been thoroughly tested and found superior to linseed oil for certain purposes. Apparently, the specifications have led to the use of inferior grades of linseed oil and have sustained the contention of the master painters, that practical tests, backed by the guarantee of a reputable manufacturer form the best basis for buying paint and varnish.

COMMUNICATIONS

INADEQUATE MAIN DRIVING BOXES

PHILADELPHIA, Pa.

TO THE EDITOR:

Your article in a recent issue in regard to the main driving boxes for large locomotives calls to mind some experience with driving boxes that were hard to get running nicely, and what I thought then and still do should be a satisfactory solution of the difficulty. The ordinary form of driving box has a bearing on only one side of the shaft, and while this has worked well in the past with small locomotives, there does not always seem to be bearing in the proper place, and it is not the best form for lubrication.

My attention was first called to this matter a few years ago, when in the mechanical department of an Eastern road. This road had some three-cylinder locomotives in high-speed passenger service which were built about 10 years ago. They were fine machines, ran fast and well, and were in general very reliable. But they had one defect—they were very hard to break in service—and even after they were running well it was always possible that they would suddenly develop hot boxes. Designed originally for grease lubrication, the first one refused to run until oil, with a force feed lubricator, had been substituted. This gave results, but after any shopping at which work was done on the driving journals or brasses there was always the same difficulty. The development of hot boxes seemed to be a matter of the attention paid to the lubrication; sometimes a locomotive working out of our roundhouse would go a surprisingly long time without any trouble, out of another it would develop a hot box in a very short time. After any general overhauling the work of breaking in the locomotive would be about as follows. The locomotive would be run leisurely up the line and back again, and on its return be looked over. But unlike the ordinary locomotive one or all of the driving boxes would be pretty warm. The waste in the cellars would then be shaken up, the lubricator filled, and they would try again. About thirty miles up the line a stop would be made, the boxes looked over and the warmest ones repacked. By this time some of them would be getting pretty hot, and these would be given additional treatment in the form of a generous amount of tallow on top of the waste. And so it would go up and down the line, always watching the driving boxes, repacking the warmest, and putting on tallow when one got real hot, the boxes cooling off one by one until finally all would run cool. Sometimes it seemed hopeless for one or more of the boxes ever to run right, and the locomotive had to go into the shop and have more work done on them. After several days or a week of running light and now and then pushing a coal train, the locomotive would be fit to start in passenger service.

The reason usually given for this trouble in breaking in the bearings is that the more uniform turning moment of the three-cylinder locomotive causes the axles to ride more steadily in the boxes and the lubricant does not get the chance to spread that it does in the case of the two-cylinder locomotive. A brief analysis of the stresses in such a three-cylinder locomotive shows that the stresses on the main boxes for a single axle locomotive alternate twice in each revolution, the same as a two-cylinder locomotive, but that this maximum is much less, and the build up more slow, so that the theory is probably correct. It seemed to me at the time, and I still believe that a different form of box with a different lubricating system would have enabled these locomotives to get into service as readily as any others. What

is needed is a box where the oil does not have a chance to get off the bearing, as it does in a box with an open cellar, and fitted so that the lubricant is applied at the point of greatest pressure.

About this time some locomotives were built, designed, as I recall, for a 104,000-lb. piston thrust and a load per pair of driving wheels of 74,000 lb. Although having two cylinders, they developed the same trouble as the three-cylinder engines—they would not run on grease. Force feed oil lubrication was substituted with satisfactory results. These locomotives had hollow main shafts which, of course, contributed to their running hot, but a little thought reveals a strange condition in the driving boxes. The piston thrust is abnormally large, compared to the weight on drivers; the spread of the cylinders is more than twice the distance between frame centers so that at certain parts of the revolution the stress on the frames due to piston thrust will be about double the piston load, about 200,000 lb. in each frame; to this must be added the proportionate share of the tractive effort, making a maximum total of 220,000 lb. for one side of this locomotive. At the beginning of the stroke the side rods cannot be counted on to carry any of the load, and this full load will be thrown on the main driving box. The vertical load on this box probably is not over 32,000 lb. The ordinary form of driving box with which the locomotive was fitted has a bearing on the top side of the shaft only, and it is cut away for a half inch or so from the center line to help lubrication. Now notice what happens in this particular case. There is a horizontal thrust on the bearing of possibly 200,000 lb. at certain parts of the revolution. There is a vertical load of only 32,000 lb. The resultant of these two will be pretty nearly horizontal, and will hit the bearing only about an inch above the center line, or about $\frac{1}{2}$ in. above the actual bottom of the bearing, and the whole load is being carried on a narrow strip at the bottom. The bearing instead of being the nominal 11-in. by 14-in. or thereabouts, is only 1-in. by 14-in., and the load, instead of 32,000 lb., is actually 200,000 lb. An adequate remedy would take the form of extending the bearing further around the axle, so that there would be bearing surface at the center line of the axle where the great frame load is applied.

Such an axle box would have the bearing covering more than half of the shaft, which would mean that it would be made in more than one piece in order to get it off. There is no insurmountable difficulty in this and probably several solutions could be found. It would mean more machine work on the new box, but the maintenance should be less. Increasing the length of the journal to give more bearing surface will not give the same results, as there is very little bearing surface to increase, and increasing the length throws the frame centers nearer together, increasing the load on the bearing. For an engine with oil—and oil lubrication is more efficient than grease—a bearing of but two pieces, completely encircling the shaft would be the thing. This could be bored to a nice running fit and should last a long time. With oil lubricant a force feed lubricator, leading the oil to the proper point on the bearing, would seem most suitable. For grease lubrication the bearing might be made in three nearly equal pieces, or made in two pieces, one large and strong enough to have a cavity to hold the grease pad.

The conditions I have mentioned are, of course, excessive for a locomotive with only two pairs of drivers, but with a powerful locomotive having five pairs the condition must be much worse. With the ordinary form of locomotive full piston load is thrown on the main crank pin at the time it crosses the dead center, but the side rods do not carry any load until it is quite a way past, and for that time the main driving box must carry all the horizontal load on its side of the engine, which is more than it can do, as it is now constructed.

GEORGE L. CLOUSER.

TRAVELING ENGINEERS' CONVENTION

Subjects Include Economical Speed of Freight Trains and Caring for Locomotives at Terminals



C. P. R. Passenger Train Leaving Windsor Street Station, Montreal, Que.

THE Traveling Engineers' Association held its twenty-seventh convention at the Hotel Sherman, Chicago, beginning September 16 and closing September 19. Following the formal opening exercises the president, H. F. Henson, road foreman of engines of the Norfolk & Western, addressed the convention.

PRESIDENT'S ADDRESS

Mr. Henson spoke in part as follows: Our last convention met during the great world struggle and at that time all our attention was devoted to bringing the conflict to a successful conclusion. We have met the challenge of war. Now let us meet the challenge of peace and securely re-establish justice, loyalty and freedom. In these trying times labor cannot afford to put itself in the position of obstructing the wheels of progress. The workers must see that not only loyalty to their country but also loyalty to its industries is essential. The conservatism and loyalty of the traveling engineers has never been questioned and they can help to influence opinion among the many employees with whom they come in contact.

After referring to the present industrial unrest, Mr. Henson made a plea for rigid economy in the use of fuel and supplies on the railroads. In discussing the affairs of the association he mentioned that the American Railroad Association has invited the Traveling Engineers to amalgamate with it and asked the members to give this consideration.

COMMITTEE REPORT ON PASSENGER TRAIN BRAKING

The following is a summary of the report of the Committee on Handling Air Brakes on Passenger Trains.

Before coupling to the train the compressor steam valve should be opened wide, the steam end lubricator feed increased to about two drops per minute for each compressor having two steam cylinders, or one drop per minute for each compressor having one steam cylinder. To assist in charging the train quickly the brake valve should be placed on lap, the maximum main reservoir pressure accumulating. To charge the train quickly release position should be used until five pounds less than standard brake pipe pressure is shown on moving the valve to running position.

BRAKE TESTS

The report outlined the procedure for making the standing brake test and also contained instructions for a brake

pipe test to be made if for any reason an angle cock or double heading cock had been closed at any time, to insure that all such cocks have been reopened. A running test to insure that the brakes can be operated from the brake valve must be made when the engines have been changed or at other times after the hose has been uncoupled or parted, also at a sufficient distance from drawbridges, railroad crossings or before going down heavy grades, so that the train can be stopped by hand brakes. The train should be left with a reduction of 20 lb. on the completion of a stop at terminals for the incoming brake inspection.

STARTING AND SLACKING

To avoid shocks, which are disagreeable to passengers and damaging to equipment, the committee recommends that where starting requires the taking of slack the throttle should be closed, the independent brake applied, the locomotive reversed and the engine brake then graduated off. Steam should be used if necessary to close in all train slack and if the train must be backed to a more favorable place for starting, the engineman should continue to work steam moderately until the stop is completed in order to have all slack closed in. The engine should then be reversed, the release of the brakes started and steam then used as carefully as consistent with starting the train, at the time when experience indicates that the holding power of the rear brakes is ending.

The independent brake should not be used in making passenger train stops.

SLACK CONTROL

Smooth handling of passenger trains requires that slack must never be changed suddenly and any heavy reduction should be avoided when speed is low; the split reduction should be used when commencing other than light applications. While applying brakes on trains of more than eight cars the use of steam should be continued, to hold the slack while the brakes are being applied where conditions will permit.

COMPLETE RELEASE

Sand should not be used while braking on good rails, except in an emergency. To completely release passenger train brakes the automatic brake valve handle should be moved to release position, back to running position and then, after waiting about seven seconds, "kick-off" should be made. The proper time in release position is indicated when the brake

pipe hand shows five or six pounds more after returning to running position than before moving from lap to release, varying from a second with a very short train to more than 15 seconds with the longest train. A release should not be attempted unless the pressure has been reduced at least seven pounds below the standard carried if the train has less than eight cars, and ten pounds for longer trains.

STOPPING TRAINS WITHOUT GRADUATED RELEASE

Stopping without graduated release from usual speeds requires the two application stop. The application should be made while working steam and using the split reduction; a reduction of about 15 to 18 lb. should be made, depending upon speed and grade. Steam should then gradually be shut off. This application having been made at a point that will reduce the speed to 12 or 15 miles an hour when about 500 ft. from the stopping point, should be released and followed by a second application of about seven pounds reduction, avoiding a total of over 10 lb. if possible.

In stopping with the one-application method from slow speeds, sufficient time should be allowed between shutting off steam and starting the brake application to permit drawbar springs to react and start the slack in, thus avoiding the action of the slack and the brake application coming together and producing disagreeable shocks. Where the one application method is being used a split reduction should be made, at first not over six or seven pounds, followed by further reduction if needed. The first reduction should be early enough to avoid making a total application of more than 10 lb. when the stop is completed.

MOUNTAIN GRADE BRAKING

Retaining valves should be used on descending mountain grades whenever the brakes cannot be recharged to within 10 lb. of standard pressure. The application should be sufficient to insure a release, so that the train is retarded by the retaining valves and not by sticking brakes. Graduated release must not be used when retaining valves are cut in, and when retaining valves are not cut in, not more than one release graduation may be used between complete recharges. Limiting the maximum speed to 30 m.p.h. on grades of 3 to 3½ per cent, and 45 m.p.h. on grades of 2 per cent to 2½ per cent, provides for avoiding much of the trouble and annoyance from burned brake shoes and an average margin of safety compared to level grade work.

DOUBLE HEADERS AND PUSHERS

When a train is to have a helper locomotive coupled on, the regular enginemen will apply the train brakes with a 20-lb. brake pipe reduction before the helper couples on, leave them applied and close the double heading cock. The helper engineman after coupling, will release the brakes and make the brake pipe test. When a helper locomotive is to be cut off, its engineman will apply the brakes with a 20-lb. reduction and leave them applied. The regular engineman will then release them and make the brake pipe test. The automatic brake valve on other than the head locomotive must not be cut in at any time or for any reason except for a plainly needed emergency application of which the head engineman is unaware or unable to make.

With a pusher locomotive on the train, the head engineman will, when the train is to be started, allow the pusher engineman to endeavor to start it. When he is using full power the head engineman will carefully assist. When the train is being stopped, the pusher engineman will continue to use steam lightly until the stop to hold in the slack.

BACKING TRAIN MOVEMENTS

When ready to make a backing train movement in which the back-up hose will be depended on for more or less control, the engineman will lap the automatic brake valve on receiving the signal to back. The man at the rear end will make a sufficient discharge from the back-up hose cock to

insure a substantial application of the brakes. On noting by the air gage and by the brakes applying that this reduction has been made, the engineman will make the usual release and proceed to back up. In such movements the automatic brake valve should be carried in running position, so that the brakes will release and recharge.

BRAKES STICKING

One cause of brakes sticking or failing to release is attempting to release a lighter application than at least 10 lb. Another cause is some brakes re-applying near the head end after releasing and a failure to make the "kick-off." Another cause is a defective feed valve which allows brake pipe pressure to vary from time to time, or a good feed valve that cannot regulate the pressure uniformly because of too little excess pressure, as a result of too low governor adjustment or a governor defect, or less excess pressure than indicated, due to an error in the gage.

[The report also took up the best methods of handling overcharged brakes of various types and the proper manipulation of the brake valve in the case of brake applications from an unknown cause.—EDITOR.]

The report is signed by T. F. Lyons, (N. Y. C.), chairman; Eugene Hartenstein (C. & A.); Fredric Kerby (B. & O.); L. S. Ayers, and W. R. Garber (K. & M.).

DISCUSSION

Mention was made of the use of gas engine oil for lubricating the air cylinders of locomotive air compressors, and L. P. Streeter (I. C.) stated that while good results had been secured with automatic lubricators on regularly assigned engines, some difficulty had been experienced in securing successful operation where locomotives were pooled. F. B. Farmer (Westinghouse Air Brake Company) expressed the opinion that a maximum speed of 45 miles an hour on descending grades was too high. In reply, G. H. Wood (A. T. & S. F.) stated that trains could be brought to a stop on descending grades from a speed of 45 miles an hour in the same distance that they could be stopped on level track from 65 to 70 miles an hour and for that reason there was no more danger involved. Where cast iron wheels were used the high rate of speed might result in extensive heating of the wheels and in that case it would be necessary to limit the speed.

ADJUSTING TONNAGE FOR AVERAGE SPEED OF TWELVE MILES AN HOUR

A railroad is most efficient when it produces the maximum ton miles per hour at the least expense consistent therewith. Engine efficiency should not be measured only by the percentage of possible tonnage handled per train, but preferably by the percentage of the maximum ton miles which can satisfactorily be handled per engine per month. Prof. W. J. Cunningham has well said:

"The time element has not generally been given the recognition it deserves. Ton miles per train hour as a unit is analogous to the horsepower unit, but instead of foot pounds per minute we use train ton miles per hour. . . .

"A large part of the expenses vary with the hours, hence it is important that the ton miles per hour shall increase. The capacity of the road in periods of peak-loads of traffic will vary with the ton mile production per train hour.

"The ultimate unit of freight car efficiency is: 'Net ton miles per car day.' . . . We are all familiar with the reasons which make it difficult to get a larger daily mileage, but sometimes it may appear that we have become too complacent in accepting these reasons as a complete explanation. In times of car shortage, an increase of one car mile per day throughout the country would be equivalent to adding about 100,000 cars to those available for service."

Apparently this condition can be but slightly improved by increasing the speed of freight trains, because of the small

percentage of the time that a car is in movement. But in this we may be deceived to a considerable extent, for in hundreds of instances which have come under the observation of every experienced railroad man, a small increase in the running time of a train has resulted in the loss of a car day for each car in the train at destination, and frequently an aggregate loss of many car days, as well as per diem charges (which may again interest us soon) at intermediate stations, terminals and junctions. An increase in the time on road also means less time at terminals for repairs, or fewer trips per locomotive. Continued exhaustive strain on locomotive parts is expensive, as such usage invariably results in failure or excessive repair work and time out of service, which, in addition to the direct expense, necessitates an increase in locomotives owned or under lease.

Generally the fuel consumed per ton mile is reduced as the engine load is increased within a reasonable limit, but the wages per train crew per trip are increased in most instances, and frequently it has been found expedient to reduce train tonnage much below the possible maximum in order to clean up blockaded divisions and thus to best serve the public as well as the stockholders. Solely on a ton mile per hour basis a gradual gain in locomotive efficiency can be shown as speed increases to thirty or thirty-five miles per hour; but when the speed of freight trains averages more than

Fully as important as any of these considerations is the psychological effect on the train and engine crews. Delays or depressingly slow movement exhaust patience and interest, and without interest and initiative on the part of engine and train crews the best performance cannot be obtained.

Aside from the psychological effect on employees, the time element in calculation of wages of train crews, at one time negligible, has become of great and increasing importance during the past few years. Speaking generally, shortening the distance between terminals, with the cost of consequent new terminals and abandonment or lessening in productiveness of many present terminal facilities, would increase charges to capital account and operating expenses excessively.

On a railroad handling many high-speed and important passenger, express and mail trains on the same tracks used by freight trains, the maximum possible tonnage per train will result disastrously; while on roads having four tracks, for example, a closer approximation to maximum possible tonnage may be satisfactorily maintained. Often on single-track roads where sidings are five or six miles apart, it is with difficulty that trains can make one hundred miles within the sixteen hours unless the average speed exceeds twelve miles per hour, excluding delays.

The committee is of the opinion that the volume and character of traffic, the physical characteristics of the roadway,



A. F. Henson (N. & W.)
President



J. A. Kell (G. T.)
First Vice-President



W. O. Thompson (N. Y. C.)
Secretary

fifteen miles per hour, many factors other than ton miles per hour affect the net economy.

The probability of costly delays and accidents increases very rapidly as the length of train approaches the present maximum. The modern locomotive usually can keep a train moving which it cannot start without running out the slack with such force as to overstrain even the best draft gears and couplers.

The probability of failure of trains to make expected movement, with consequent expensive road and yard congestion, increases rapidly as train tonnage closely approaches the possible maximum, even though there is no breakage.

The modern locomotive attains its maximum fuel and thermal efficiency at speeds of not less than twelve miles per hour while working at approximately 25 to 30 per cent cut-off. As the cut-off is increased, the thermal efficiency decreases rapidly. At lower speeds, high degree superheated steam is not obtained, and the possible economy from this source is not realized. Superheater locomotives are capable of higher sustained speeds than saturated steam engines capable of dragging the same load, and full advantage should be taken of this superiority. On low grade divisions where it is necessary to half stroke or in many instances to nearly full stroke the engine most of the way between terminals, these features are worthy of careful consideration.

and the locomotive equipment vary so greatly on the several roads and in many instances on the various divisions or sections of the same system, that the problem of determining the most suitable average speed and tonnage for freight trains generally must be solved for each division or district. Numerous carefully conducted road tests and expert analysis of performance and cost records should be made to determine the most economical operation.

We believe that with very rare exceptions an average speed of more than twelve miles per hour for tonnage freight trains can be attained and maintained without reduction in the properly determined maximum allowable tonnage, and that this tonnage will exceed the present rating in some instances, if the transportation and mechanical departments co-operate effectively in determining the proper rating, and if the officers of these departments, as well as those in the maintenance of way department, put into regular use every possible means for the elimination of delays.

[A table was included in the report showing the average freight train speeds maintained by 23 roads over a period of 10 months. With three exceptions these were all less than 12 m. p. h., the arithmetical average being 10.8 m. p. h.—EDITOR.]

The report was signed by H. C. Woodbridge, chairman, E. F. Boyle, J. S. Meidroth and F. R. McShane.

DISCUSSION

Several members spoke on the necessity for co-operation between the traveling engineer, trainmaster and despatcher in order to reduce delays and increase the average speed of trains between terminals. The prevailing opinion was that there is little danger of overloading locomotives if the main journal bearings are kept in good condition.

THE ADVANTAGES OF STOKERS ON MODERN LOCOMOTIVES

Heretofore, in considering the application of mechanical stokers to locomotives we have thought in terms of the present only. The time is now at hand when we must consider future needs. Man power and wage costs are the dominating factors, and for economical operation we must use machinery to do work that at one time could profitably be performed by hand. The economical rating of a locomotive is no longer the greatest tonnage it can haul over a division regardless of time, but the greatest tonnage it can haul over a given distance in a given time.

Ever-increasing wages makes it necessary to get more work out of the machines, and we can no longer limit the capacity of the modern locomotive to the capacity of the fireman to shovel coal.

The advantage to be gained by the application of stokers is the realization of maximum boiler capacity, not only through sustained periods, but at any time when needed. The necessity for using mechanical devices arises, not only from a humanitarian standpoint, but more particularly to develop 100 per cent efficiency in each individual, and as this factor enters into the effectiveness of the locomotive more than any other part of railroad operation, it would seem to be the strongest recommendation for the installation of mechanical stokers on all power that is kept in road service.

Years ago the capacity of the firemen at times governed the amount of work performed and not the capacity of the locomotive. There were two reasons for this: First, it is impossible to educate any two men up to a point where they will fire a locomotive exactly the same under all conditions and look ahead to be prepared for any emergency; second, the physical capacity of men to perform the work. The stoker makes it possible to have every engine 100 per cent effective. In some instances it is possible to get full capacity out of the locomotive, while in other instances, even with experienced men, it is not. Therefore it is only fair to assume that the amount of work performed by any given number of locomotives in any given territory will be based on the average poorest firemen on that division rather than on the average best firemen. With the engines equipped with mechanical stokers, receiving proper attention at terminals and by the men on the road, each will give practically the same service.

There is no question but that a scientific job of firing largely affects steam chest temperatures when using superheated engines. By some tests conducted on a superheated engine it was demonstrated that it was possible to increase the steam chest temperatures from 20 to 50 deg. by expert firing, as compared with the work of the regular fireman on the job. Uniform temperatures in the fire-box, together with perfect combustion, will give the highest steam temperatures possible to obtain, and as it takes a given amount of air to produce perfect combustion from a given amount of coal, and as the admission of air to the fire-box can only be regulated by the depth of the fire on the grate, it can readily be seen that in firing an engine by hand where the fire-door has to be opened to admit of the fuel charges, that the admission of air to the fuel bed through the grate must be intermittent, either too much when the door is closed or not enough when the door is open.

The stoker makes it possible to carry the water at a lower uniform level than with a hand-fired engine, for the reason

that the steam pressure can be maintained at any time even though the engine is being worked to its maximum capacity through any sustained period.

In all the comparative tests that have been made between the stoker and hand-fired engines no one seems to have come to the same definite conclusion regarding fuel consumption. We have found that in using the same grade of coal with the stoker and hand-fired engines, the boiler capacity of the engine not only is increased to a great extent as far as handling tonnage is concerned, but that it materially reduced the running time between terminals; therefore, with the present stoker in its perfected form, it should not only show much greater efficiency than a hand-fired engine, but also effect a very material reduction in fuel consumption.

Considerable stress is placed on the stack losses of stoker-fired engines due to the extremely fine quality of coal necessary to use on them. With the present perfected stoker and the brick arch extending well back to the door sheet, the stack losses can be reduced to a point nearly as low as is done by using run of mine coal hand fired. In some large Mikado type engines, where originally they used six bricks in the arch, the arch was extended up to within about seventeen inches of the crown-sheet. This not only has made a saving in stack losses, but almost entirely eliminated the smoke. With an arch of this kind and a large combustion chamber it would be possible with careful manipulation to burn 98 per cent of all fuel in the fire-box.

The firemen are demanding another increase, and in addition are requesting that all engines above a certain limit be equipped with mechanical stokers, and all under that limit be equipped with mechanical coal passers and grate shakers. Considering the cost of the mechanical coal passer and grate shaker, it would be much better to take the money expended in this way and equip all engines kept in road service with a stoker.

While committees reporting on this subject in the past have never been able to secure reliable information, records for the past five years show our maintenance cost to have been a little under \$10 per thousand miles. As to engine failure due to stoker trouble, the records of the El Paso & South Western show an average of 61,556 miles per stoker failure. The application of stokers on this line has entirely eliminated the stereotyped engineers' report of "engine not steaming." As a rule the size of nozzles has not been increased, but it has been possible to adopt a standard front end and make all engines give a uniform service as far as steaming is concerned. It was never possible to get any class of engines to steam alike when hand fired. One fireman would want a bridge in the nozzle, while another wanted it out; one would want the draft-sheet 15 in. from the bottom of the arch, while another wanted it 21 in.; one would want the petticoat adjusted one inch above the nozzle, while another man would want it six inches. With the stoker, however, practically no work on front ends is necessary by the round-house force except to make regular inspections.

Owing to the constantly increased coal burning capacity of the locomotive, the application of a mechanical means of supplying the fuel is the only thing that will make the work sufficiently attractive to get and keep the right kind of men on our engines.

The report was signed by E. Gordon, chairman, J. A. Cooper, A. N. Willsie, J. O. Clendenin and J. R. Bissett.

HANDLING LOCOMOTIVES TO SECURE EFFICIENCY AND FUEL ECONOMY

The essential requisites to locomotive efficiency are proper design, proper operation and proper maintenance of power, the matter of fuel economy always being closely related to any of the three. The matter of proper design should start with having the boiler and grate area designed of ample proportion to furnish enough steam to develop the maximum

cylinder horsepower of the cylinders at all times. Every modern locomotive should be equipped with superheater, brick arch and power fire-door; all of which are fuel-saving and capacity-increasing devices. The combustion chamber also makes for fuel economy and is now in successful use on most large locomotives. The mechanical stoker should be applied to all large engines, and although the conditions under which the engine is to operate would govern, generally speaking, engines with over 50,000 lb. tractive power ought to be stoker fired.

Air compressors and headlight turbines of modern and most economical design should be used on new power, and on some old power it will be found in the interest of economy to replace existing auxiliaries with the more economical outfits. There are some as yet undeveloped sources of fuel economy for locomotives, one of which, the feed water heater, while still in the experimental stage, will undoubtedly soon be perfected and put in more or less general use.

In designing the engine, front end, grates and ash-pan should be given plenty of attention. It is necessary to keep the air out of the front end, and yet admit it in plenty to the ash-pan, which means ample ash-pan air openings and all joints tight around the front end. The exhaust nozzle should be made as large in diameter as possible, so as to reduce back pressure and yet furnish the draft required to produce proper action on the fire. The grates should have ample air opening and the grate rigging should be such as to permit shaking freely by the fireman, which cannot be done if too many sections of grate are carried on one shaker.

ESSENTIALS FOR PROPER OPERATION

It is recognized that where locomotives are pooled they are not so well maintained, as the engine crew does not take the same interest in an engine that they may not see again for a month; and they do not make the lighter repairs, nor the thorough inspection and report of defects en route which they do in a case of the regularly assigned engine. Although it may be more economical in general to use pooled engines, particularly when business is heavy, there are instances where regularly assigned engines could be used, and it is preferable to do so when consistent.

Locomotive performance is affected to a considerable extent by the terminal facilities. Terminal facilities may often include various fuel or labor-saving appliances, but these are not always installed in co-ordination with other appliances at the same terminal. Proper terminal layout should be such as to get the quickest movement into and out of the engine-house of engines arriving at and departing from terminals. Considerable fuel is lost, the expense of handling the engine increased, and there are many delays due to improper design of terminals.

Wherever it is possible to change an existing water supply for one of better quality, it should be done, providing the cost of the change is not prohibitive, and then, having obtained the best available water, every water should be given the necessary treatment to prevent scale formation and corrosion within the boiler. Fuel lost from having scaled heating surfaces is a large expense; boilers operate at reduced efficiency when scaled up; engines fail and give up trains on account of flues leaking, and the cost of boiler maintenance is much higher on account of frequent flue, stay-bolt and fire-box renewals. Engine failures due to leaking can be reduced to practically nothing; staybolt trouble can be reduced to a minimum, and considerable fuel will be saved with the proper treatment of all waters.

MAINTENANCE OF MACHINERY AND BOILER

Proper maintenance depends first on proper inspection and then on getting the defects corrected which are brought out by this inspection. The pooled locomotive can be run successfully and efficiently if there is adequate terminal inspection and repair.

Not infrequently the officer in charge of the terminal is under the impression that the only inspection necessary is searching for loose nuts, missing parts of machinery, cracks, hot bearings, etc., and consequently uses rather low-grade men for this purpose. The best man on the job is none too good for inspection, as a locomotive ought to be tested for steam blows, pounds and such defects as cannot be observed by the eye alone.

If the inspection and repair of locomotives were carried out in accordance with federal inspection laws good results would be secured. All repairs found by the inspector ought to be made, and when possible a check should be made before the engine leaves to see that all work has been done.

A few items of maintenance, or shop practice, that might be mentioned are care in laying out shoes and wedges, and proper maintenance of binders, tramping of engine trucks, drivers and tender trucks, and the fastening of valve bushings so that they cannot move, making it possible to use standard rings for all engines of a class. It will frequently be found that the steam distribution is not correct for engines of the same class, due to slight differences in the position of the valve bushing and size of valve rings used.

Perhaps one of the most important items of maintenance is the proper care of superheaters and superheater flues. The superheater is the greatest fuel-saving device, and as the saving in fuel depends on the amount of superheat, it follows that any obstruction which prevents free passage of the hot gases around the superheating units will result in a reduction in superheat and a corresponding reduction in the efficiency. It does not take many trips for superheater flues to become stopped up and unless constant attention in the way of blowing them out in roundhouses is given superheaters will be found only saving perhaps 50 per cent of what they should when properly maintained.

FUEL DEPARTMENT ORGANIZATION

Although fuel economy depends on proper design, proper operation and proper maintenance of power, it is necessary in order to get real results to have a separate fuel organization. This should consist of a general staff officer, in charge of fuel conservation, who should devote his entire attention to the conservation of fuel on locomotives, in shops, at terminals, water stations and for all miscellaneous purposes. He should also have jurisdiction over the quality, preparation and uniformity of coal furnished.

To carry out his plans, the general fuel officer should have divisional fuel supervisors, who should be assigned a certain territory for all the various details of fuel economy, but whose principal duty should be the education of firemen in the economical firing of engines. The fuel organization should have enough clerical assistants to keep up-to-date records of fuel performances by individual engine, by engineer and by fireman, so that performances on any division can be known and examined at any time. These records give means of locating the cases where an engine or an engine crew is operating wastefully, and they also show what progress is made in saving fuel.

Monthly divisional fuel meetings should be held with the superintendent, master mechanic, divisional officials and such employees as can consistently attend. General fuel officials should attend these division fuel meetings as often as possible, but the superintendent should be the chairman of the divisional fuel committee and conduct the meetings, as this brings about a more thorough and more uniform understanding of the importance of various matters effecting fuel economy by operating officials who otherwise might overlook some of the details and leave it up to the mechanical department.

Any progressive movement must be backed by educational efforts and great stress is laid on the necessity of constant education of enginemen particularly, as they, of all employees,

are most responsible for the coal pile, and also of all others who in any way may be concerned in the use or waste of fuel.

The report is signed by J. B. Hurley (Wabash), chairman; Robert Collett (U. S. R. A.); F. P. Roesch (U. S. R. A.); B. J. Feeny (U. S. R. A.); and G. E. Anderson (Gt. Nor.).

DISCUSSION

W. G. Wallace (American Steel Foundries) emphasized the importance of having a record of the coal consumption immediately available at the end of each trip. If this information is given to the train dispatcher at the end of the run, it makes it possible to check up the coal consumption, taking into account all the conditions surrounding the trip. This helps greatly in fixing the responsibility for excessive fuel consumption, whether it is due to the operating conditions, the mechanical condition of the power or the quality of the coal. E. Hartenstein (C. & A.) mentioned the losses due to slow orders and unnecessary stops. He also touched on the qualifications of locomotive inspectors and stated that men who had received their training in road work were often better qualified than men from the shop. V. C. Randolph (U. S. R. A.) called attention to the important part which the locomotive engineer must play in securing economy in the use of fuel, and advocated that these men should be taught how to operate the engines at the greatest efficiency. Among the common wasteful practices he mentioned especially working the locomotive harder than is necessary. H. C. Woodbridge (U. S. R. A.) stated that irregular action of reverse gears was often responsible for excessive fuel consumption and expressed the opinion that it is necessary to make improvements in these devices. A. G. Kinyon (Fuller Engineering Company) advocated a fuel department organization reporting to the chief executive officer. He brought out that instruction must be supplemented by adequate supervision to get the best results. B. J. Feeny (U. S. R. A.) stated that too much attention is given to accounting for oil and far too little attention to fuel records. He also emphasized the fact that the responsibility for saving fuel extends to all departments.

CARING FOR LOCOMOTIVES AT TERMINALS TO SECURE EFFICIENCY AND INCREASED MILEAGE

Assuming that locomotives come from the shops in condition to readily develop the state of efficiency for which they are rated, the efficiency that can thereafter be maintained and the mileage obtained, will depend largely upon the thoroughness of the work done upon the locomotive during general overhauling periods. The limited facilities of the average terminal plant should not be required to make good the shortcomings of the general repair shops.

Increased mileage is but another term for maintenance of a high efficiency, as it presupposes less delay along the line due to locomotive troubles, quicker turning at terminals for service and a greater number of trips between shoppings. The efficiency of the practices in use at terminals, the extent of the facilities available for doing work and the excellence of the work done will in a general sense determine the measure of efficiency that can be expected to be maintained at such places. It follows that a constant striving for the betterment of practices, of facilities and of workmanship, are the essential needs at terminals to maintain locomotives in an efficient state and to increase the mileage obtainable. The traveling engineer should be of valuable assistance to those in charge of terminals in bringing these betterments about.

The question as to what are the best methods of caring for locomotives at terminals is synonymous with, what constitutes good roundhouse practice?

Studied from any angle, these two questions constantly intermingle and seemingly resolve themselves into the identi-

cal set of fundamental requirements which, in turn, constitute equally the basic principles of good roundhouse practice and of locomotive maintenance.

These requirements are: Caretaking inspection of the locomotive by competent locomotive inspectors as soon as possible after arrival at terminal; the obtaining of an intelligent report from the incoming engineer as to the conditions noted during his trip; the proper cleaning of the fire, ash-pan and front end, and attention to the fire and water while lying at the terminal; a careful inspection by competent workmen of the troubles and defects as reported by the engineer and locomotive inspectors and the making of the necessary repairs and changes in an efficient manner; the furnishing of the proper engine tools and the necessary supplies for the outgoing trip, which will include filling of lubricators and rod cups; frequent riding of the locomotives by the traveling engineer.

With the exception of the last mentioned point, these requirements are incidental to every trip in either direction where inspection and repair facilities are provided for at each terminal. The maintaining of efficiency demands that these requirements must be provided for and carried out at least at the end of each day's work, and is required by the Interstate Commerce Commission rules.

In addition to the points already mentioned, provision should be made for periodical inspections not usually covered in work reports, which will include boiler washing, boiler inspections and inspections of the operating parts enumerated later on; for the carrying in stock of needed supplies of all kinds for making the repairs and for renewals, and for shop equipment and tools necessary for reasonable running repair maintenance.

ENGINEERS' REPORTS

As there are certain troubles and defects such as steam blows, pounds, and conditions affecting the steaming properties, which are only discernible when the locomotive is working, an intelligent report from the engineer as to the conditions noted while running on the road, is of the greatest importance.

There is scarcely a way in which the traveling engineer can be of more use to the mechanical department and be of greater aid in assisting to keep locomotives in an efficient condition than in seeing that engineers' work reports are made out in such a manner as to clearly indicate the nature of the defect, and in cases where a definite cause cannot be given describe just what takes place.

LOCOMOTIVE INSPECTION

The Locomotive Inspection Bureau of the Interstate Commerce Commission has issued rules governing the inspection of locomotives, and including limitations of wear permissible for certain parts. These rules are based upon the practical experience of both the federal inspectors and representatives of the most important railroads of the country, and failure to live up to them constitutes a violation of the law.

Carried out in the spirit intended, they stand for good maintenance. Where observed, however, only within the letter of the law, a high state of efficiency is not necessarily indicated, as many of the rules do not cover the best conditions obtainable, but rather the poorest allowable, and the limitations below which it is not permissible to go. The inspection should be thorough and painstaking, inasmuch as defects that result in delays, breakages and failures, are quite frequently discernible only under the very closest scrutiny.

In addition to those parts covered by the rules, every part subject to wear that would interfere in any way with the efficient working of the locomotive and all parts subject to severe strains, breakages, or loosening effects, including nuts, keys and cotter pins, as well as the condition of all

safety appliances, should receive attention. It is a good plan to have an outgoing inspection, covering conditions of air brakes, injectors, electric headlight, and power reverse gear, and for the examination of such parts of the locomotive as were reported for shop attention.

Where for any reason the fire is dumped at the terminal, suitable provision should be made for the inspection and testing of steam and air-operated devices, such as the air brakes, injectors, electric headlight, power reverse gear and similar devices, while still under sufficient steam pressure to operate such parts. This guards against defective conditions in such parts, gives opportunity for repair if any defects are found, and in the case of air brakes, provides for the testing and the adjusting of the piston travel within the proper limits.

All locomotives should be cleaned in order to facilitate the work of inspectors and shop men.

SHOP FACILITIES AND TOOLS

Where the facilities of a general or so-called back shop are not readily accessible, adequate means for doing light repair work of a reasonable nature should be provided in the way of a small machine and blacksmith shop. This should contain at least a lathe, a small shaper, a drill press, a press for pushing bushing in and out, a blacksmith forge and a grindstone. Such a plant is almost invaluable, providing for both quicker and better work as well as assisting in cutting down the cost of maintenance. A supply of tools such as drills, taps, reamers, dies, files, wrenches, pipe fitters' and boiler makers' tools and others not usually provided by the workmen themselves should be at hand.

The weight of various parts which have to be handled demands the use of portable cranes, jacks and block and fall, and these should be provided for quick and safe work. An electric or other type of welding machine has also become a necessity in terminals of any size.

SUPERVISION, QUALIFICATION AND METHODS

Competent supervision over mechanical activities at terminals is a most important factor in efficient locomotive maintenance. Men for these positions should be chosen with particular regard for their experience, good judgment, foresight and resourcefulness, as well as for their ability to handle men. Frequently located at points distant from any large terminal through which immediate assistance could be procured, often with poor facilities for doing work and none too competent help, their success or failure depends largely upon their own capabilities.

Resourcefulness is necessary in devising ways and means to meet the varying conditions incidental to running repair work and the emergencies that are constantly arising. The interest taken in the work by the supervision will be a dominating feature in the results achieved. Not only should the workmen be watched to prevent loose methods and bad practices creeping in, but the completed work should be frequently examined as a guard against poor work and carelessness.

TURNING POWER

Features other than the maintaining of an efficient locomotive enter into the matter of increased mileage and as they have to do with the care of the locomotive while at terminals, they must be given due consideration in connection with terminal work.

Increased mileage necessarily implies a greater number of trips to be made between shoppings and conditions at terminals which interfere with the promptness with which locomotives may be reached for the purpose of making needed repairs and prepared for a quick return to service, tend to prevent increased mileage.

It is usual to consider the cleaning of fires, the obtaining of coal and water and the turning of the locomotive as

adjuncts to the maintenance and care of power. The provisions made for doing this work and the ease with which the locomotive can reach the points where the work is to be done, is most important in the quick turning of locomotives as a means of bringing about increased mileage. Inadequate provision in this respect slows up terminal movements, hinders prompt repairs, tends to hurried repairs and to work being left undone. It frequently leads to badly congested conditions and serious delays, and fosters carelessness in the various stages of preparing the locomotives for return to service on account of the necessity of crowding them through the terminal in order to turn them with any degree of promptitude, and in general results in poor conditions and delays.

Poor facilities in this respect are especially troublesome at terminal points where severe winter weather is experienced and during such periods they may be the cause of power conditions becoming very serious.

The trackage about terminal plants insofar as it provides for prompt and free movement of the locomotive in conjunction with cleaning fires, obtaining coal and water, getting to and from the turntable and in reaching and departing from the shop, is important in giving more time for the making of repairs and lessening the time required for preparing the locomotive for dispatching. In a like manner the adequacy of the provisions made for cleaning the fires, for inspection purposes and for coaling, have an important bearing on the time necessary in getting the locomotive ready for service.

RESPONSIBILITY OF THE TRAVELING ENGINEER

The duties of the traveling engineer place upon him a considerable share of the responsibility for the maintenance of the locomotive over which he has nominal control. Being in constant touch with all the conditions that enter into their handling both at the terminals and on the road, he cannot well evade such responsibility.

In various ways, as casual inspection of methods used and work being done when he is around terminals, riding the locomotive, investigation of delays and failures and through his contact with the locomotive crews, it is within his power to know just what conditions are. He has the means of knowing whether his engineers are making intelligent reports or not by occasionally looking over their work reports. He has the means of knowing by personal observation and by information gained from delay and failure reports whether inspectors are competent and painstaking in their work or not. He should know whether or not fire, ash-pan and front-end cleaning is being done properly, and the locomotive cared for in a proper manner while laying over. He should know by the results obtained as well as by the complaints of the locomotive crew, by his personal experience in riding and by results of investigation of delays and failures whether the work being reported is being properly done or neglected. He can easily ascertain what is done with reference to boiler inspection during boiler washing periods and to other parts during periodical inspection.

In the extent to which he avails himself of this information, and the use to which he applies it will lie the measure of his share of the responsibility for the conditions which exist. It is scarcely sufficient that he is able to say in explanation of poor conditions that the work required to better conditions was reported. He must be able to show that he made use of all the means within his power to bring about a betterment of conditions. It comes well within the scope of his authority to consult and advise with those in charge of terminals as to conditions that are detrimental to maintenance and efficiency.

He will almost invariably find that the information and advice that he can offer will be most gladly received. As a rule the terminal authorities are more given to complaining

of the lack of assistance given them by the traveling engineer than in regard to his insistence on better conditions.

The traveling engineer should take particular interest in the prevention of practices which tend to decrease locomotive efficiency, such as moving engines without opening the cylinder cocks, with its ill effects on cylinder and piston rod packings and the slipping of locomotives in starting them, with its general racking strains.

The report is signed by T. F. Howley, chairman, Joseph Keller, B. J. Feeny, C. W. Corning and J. W. Burrows.

DISCUSSION

W. H. Gallagher (M. K. & T.) advocated a method of adjusted tonnage rating as a means of securing greater efficiency from locomotives. E. R. Boa (N. Y. C.) brought out the necessity for cooperation between the traveling engineer and the roundhouse foreman. F. L. Pierce (C. & A.) described a method of inspection of outgoing engines by traveling engineers which had brought good results. E. F. Boyle (So. Pac.) spoke of the damage to locomotives resulting from improper operation by hostlers, who often moved the engines when cylinders were filled with water. B. J. Feeny (U. S. R. A.) stated that while good facilities were necessary to secure the best results, a fair degree of efficiency could be secured by giving attention to simple matters which required no elaborate equipment, such as blowing tubes and cleaning grates, as these matters have a great influence on the operating results secured with the engines. W. L. Robinson (B. & O.) mentioned the abuse of locomotives by incompetent hostlers, and stated that traveling engineers should have authority over these men and should instruct them in the proper method of handling engines. E. S. Boyle (So. Pac.) stated that, as a rule, if all the work reported by the enginemen is done, the motive power will be kept in fairly good condition. It is, however, necessary for the traveling engineer to see that the men do not fail to report necessary work. He advocated occasional joint inspection by the traveling engineers, general foremen and master mechanics to check up the engineers' reports. A resolution was passed stating that in the opinion of the association there should be responsible engine inspectors and night roundhouse foremen at all engine terminals.

OTHER BUSINESS

At the session held on Friday, the report of the committee on amalgamation with the American Railroad Association was received and discussed. The committee stated that in view of the fact that the duties of the traveling engineer were not strictly mechanical work nor transportation work, but a combination of the two, it believed that the best results would not follow from amalgamation as a division of either the operating section or the mechanical section, but by the creation of a separate section to take over the activities of the Traveling Engineers' Association. This course had been suggested to the officers of the American Railroad Association, but no answer had been received, and in view of this situation the committee was continued.

The by-laws of the association were amended to leave the selection of the place of meeting entirely in the hands of the executive committee.

The following officers were elected: President G. A. Kell, Grand Trunk; first vice-president, W. E. Preston, Southern; second vice-president, L. R. Pyle, Railroad Administration; third vice-president, E. Hartenstein, Chicago & Alton; fourth vice-president, J. H. DeSalis, New York Central; fifth vice-president, E. F. Boyle, Southern Pacific; secretary, W. O. Thompson, New York Central; treasurer, David Meadows, Michigan Central; members of executive committee, F. P. Roesch, Railroad Administration; B. J. Feeny, Railroad Administration; J. Keller, Lehigh Valley.

FRONT ENDS, GRATES AND ASH PANS*

During the past few years much attention has been given to results obtained from the performance of heavy Mikado and Santa Fe type locomotives. The committee felt that an analysis of some of the apparatus pertaining to the designs of front ends, grates and ash pans was pertinent, and accordingly sent a letter to the mechanical engineers of some of the larger railroads of the country, reading in part as follows:

"In connection with work by the Standing Committee on Front Ends, Grates and Ash Pans of the International Railway Fuel Association, we wish to compile data in regard to improvements in designs of front ends, grates and ash pans which some of the more important railroads have found to produce a saving in fuel. We would like to have this data in connection with the larger type locomotives, preferably the Santa Fe or the Mikado types.

"If your railroad has found a change in design within the last two or three years which is proving to be a more economical design than you originally had on front end arrangements, on grates or on ash pans, also if the designs you now use are giving very good economy, will you please send drawing showing the old and new designs and also advise as to the size of the locomotive, the class of service, the grade of fuel burned and any further information which you see fit to give regarding both old and new designs."

The response to these letters, together with information submitted by individual committeemen, has suggested a comparison of present practice with the practice of some fifteen years ago, particularly in reference to front end design when the Master Mechanics' Association in 1906 endorsed the Purdue University tests on front ends.

The fundamental principle of the Master Mechanics' standard front end is that the height, H, of the portion of the stack extending above the smoke box and the distance, h, that the exhaust nozzle is below the horizontal center line of the smoke box be, for best results, as great as practicable. This being done, dimensions of certain importance are ascertained in accordance with the following formulae in which D is the diameter of the smoke box, P the distance the stack extends below the top of the smoke box, d the diameter at the choke of the stack, b the diameter of the base of the stack, and h the distance from the base of the stack to the choke or smallest dimension of the stack.

$$\begin{aligned}d &= .21D + .16h \\b &= 2d \text{ or } .5D \\P &= .32D \\p &= .22D\end{aligned}$$

It is to be remembered that the diameter of the smoke box on which tests were made in establishing the design factors for the standard front end was 74 inches, and that the maximum back pressure of the exhaust blast that produced the draft on this oil-burning locomotive was only a little more than 4 pounds. These are conditions which do not prevail in general practice today. The diameter of the smoke box on the majority of larger engines is from 80 to 91 in. and the back pressure is far in excess of a maximum of $4\frac{1}{2}$ pounds.

The function of the stack is a very important one in its relations to the drafting of the locomotive and its fuel economy. The diameter at the choke of the stack, as determined by the standard formula, is made a function of the diameter of the smoke box, as well as the distance of the exhaust nozzle below the center line of the smoke box. The question arises whether or not this is a proper basis of design with present-day practice with large locomotives, either using saturated or superheated steam, hand fired or stoker fired. Is this the proper equation to give maximum fuel economy? Does it

*Abstract of a committee report presented before the International Railway Fuel Association at the convention held in Chicago, May 19-22, 1919.

give a stack that is large enough to take care of the exhaust steam and the exhaust gases and to deliver them properly and with such a degree of freedom that good fuel economy results?

By comparing the formulae with the practice on present prominent railroads, we find that the maximum calculated diameter of the stack at the choke is 23 in. and that the actual diameter is 21 in. In this case the minimum area of the actual stack is 17 per cent below that required by the formula; no data have been established by experiment on this coal-burning Santa Fe type superheater locomotive to show that a 23-in. or larger stack might not be used.

This railroad in question is notably a leader in the large size of its stacks. Another railroad in an adjacent territory is using a 17-in. stack on this same type of locomotive.

An analysis of all the design dimensions referred to by the formulae is of great interest as a matter of comparison, and one might possibly draw the conclusion that the dimensions were made to suit other conditions and not made to follow the formulae in that they vary as much as 100 per cent in several instances.

What, then, is the state of the standard Master Mechanics' front end? It may possibly be expressed in the words of a prominent mechanical engineer when he said recently: "So far as present large power is concerned, there is no such thing as a standard Master Mechanic front end. On present-day power, using superheater steam, the arrangement will not permit such a front end."

The Master Mechanics' front end did not provide a front end netting which is common to most locomotives of today, so located as to extend from the table plate at an angle of about 40 degrees to the forward part of the smoke box. This location of the netting for interception of the exhaust gases makes accessibility of the front end rather difficult, and many designers have expended their efforts in developing a different arrangement of the netting or spark arrester.

The Chicago and North Western has had for several years a box arrangement known as the Slater front end which is claimed to give very satisfactory results. The Burlington has an arrangement differing widely from that of other railroads so far as form is concerned, having a basket form over the exhaust pot. The Rock Island has a cylindrical

tives, we find that they are for the most part of the finger type, and are divided into four sections. During the past few years power shakers have been introduced on a considerable number of the larger locomotives. In such case the arrangement is such that the grates can be shaken either by power or by hand and, of course, in a very much shorter time than by the former method.

There is a tendency on the part of several railroads to change from the finger type grates to the table type. Tests recently made on one road show a decided saving in fuel due to the change from the finger to the table grates.

Ash Pans.—The general design of ash pans must necessarily be adapted to the particular class of locomotives, some locomotives permitting a different arrangement than others. In general it would appear that the ash pan is designed to fill a space that has been left over after other parts of the locomotive have been utilized to the best advantage. So far as the type of hopper is concerned, it seems that the duplex hopper type is in most general use, although there are a considerable number of multiple hopper type ash pans in service.

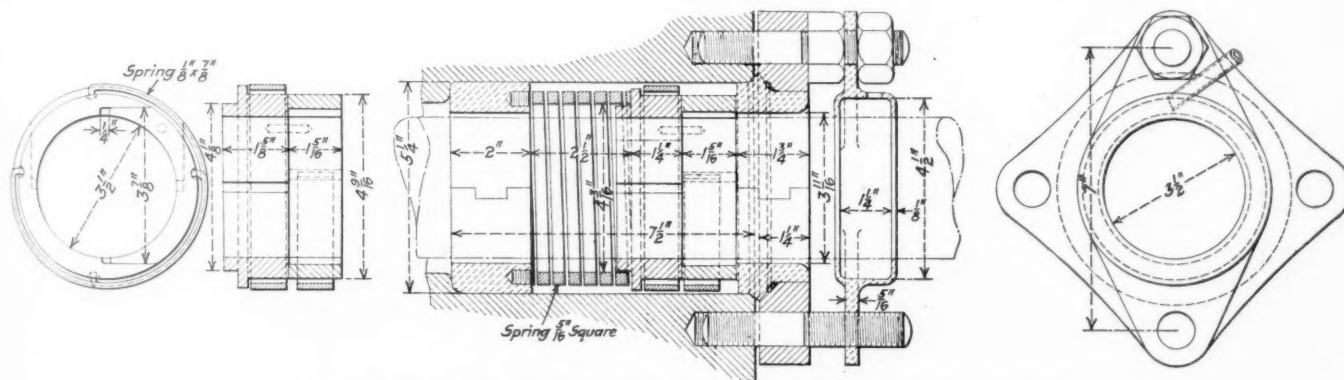
In general the ash pan doors open so as to dump the ashes towards the back end, although on a few railroads the two doors open, the one towards the front and the other towards the back of the locomotive.

In many instances the mechanical engineers are not co-ordinate in their actions; the designs that are satisfactory on one railroad are sometimes discontinued on another. This is particularly true with reference to the sliding versus the hinged door.

The report was signed by H. B. MacFarland (A. T. & S. F.), chairman; W. J. Bohan (N. P.), E. B. DeVilbiss (Penn. Lines), J. P. Neff (Am. Arch Co.), and Frank Zeleny (C. B. & Q.).

CAST IRON PISTON ROD PACKING

Two of the prominent railways of Great Britain, the London & North Western and the North Staffordshire, having experienced difficulty with their white metal piston rod packing on superheater locomotives have successfully developed a cast iron packing which has given particularly good service for some little time. The packing used on



Cast Iron Piston Rod Packing Used on the London & North Western

spark arrester. (See *Railway Mechanical Engineer*, January, 1919, page 41.)

"This road has several hundred locomotives fitted with this device, with the most gratifying results."

With these variations of designs of front ends the question arises with this committee as to what should be endorsed as the best form of arrangement of a standard front end and what should be the basis of design of the stack under present day conditions. At this time the committee is unable to make recommendations.

Grates.—In studying the grates in use on large locomotives,

both these railroads is made in their local shops. The London & North Western uses a mixture of 40 per cent selected scrap, 30 per cent Kettering silicious material and 30 per cent old ingot molds (Hematite). The North Staffordshire railway makes its packing from an ordinary commercial quality of cast iron with approximately 33 per cent Barrow Hematite added.

On both these roads the cast iron packing is used with modern locomotives, both in freight and passenger service. The North Staffordshire railway uses the cast iron packing on saturated steam locomotives as well as on the superheated

FIREPROOF TERMINAL OIL HOUSE

Floor Plans of Tank Arrangement and Details of Apparatus for Convenient Handling of Oil

BY ALBERT P. SHARP

THE housing and handling of oils is a subject that has been given considerable study and a layout of an ideal arrangement for a railroad terminal fireproof oil house is shown in the illustrations. This house is equipped with eight tanks of 24 barrels capacity each, but can be enlarged upon or reduced without changing the method of handling the oils.

In this plan a special study has been made of safety and convenience with the greatest economy in handling oils and other materials that are usually kept at a station of this kind, such as waste, engineers' cans and kits.

The oil is received from cars, the floors of which are on

stop cock and check valve, the latter placed to open away from and thus insure no air reaching the main tanks.

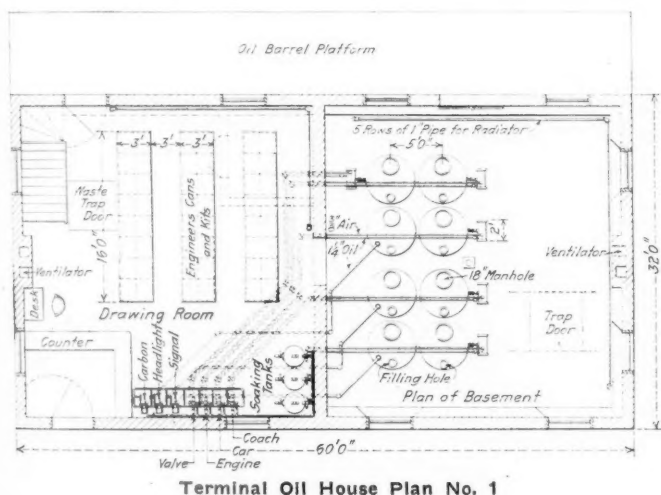
Special attention is called to the arrangement of piping, faucets and delivery counter and to the combination cock or faucet, used in drawing oils, by means of which air pressure is admitted to the auxiliary tanks only during the process of drawing and by the same movement used for drawing the oil, thus eliminating a continuous air pressure on the oil and its resultant moisture.

The convenient arrangement of faucets and delivery counter reduces the time necessary for the delivery of oil to a minimum.

The air enters a receiver placed in the basement, and provided with a connection to a sewer and a stop cock for the purpose of blowing off occasionally and removing any moisture or foreign matter that might have accumulated. It then passes from the receiver through a stop cock, thence through a pressure regulator to faucets at the delivery counter. The regulator is set to avoid splashing of the oils when drawing.

Provision is also made for soaking tanks for the preparation of journal packing, the oil being supplied to these tanks by air pressure also.

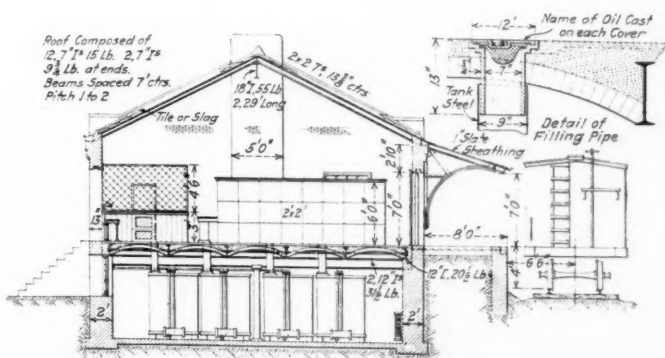
While the number of locomotives and cars to be taken care of did not enter very largely into the design of the oil house shown in plan No. 1, it was worked up for the express purpose of showing an ideal arrangement which could



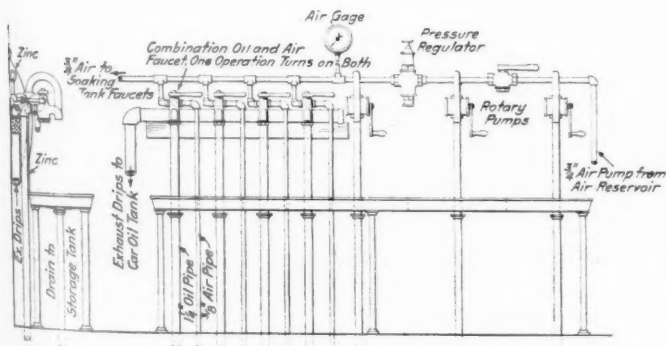
Terminal Oil House Plan No. 1

a level with the receiving and shipping platform and is transferred from barrels to the tanks in the basement by gravity through filling pipes, provision being made for the elimination of foreign matter by having the oil pass through a suitable screen or sieve before reaching the tank. The name of the oil contained in the tank is cast on the lid of the cover of the filling box.

All lubricating oils are drawn from tanks by air pressure,



Cross Section of Oil House and Filling Pipe—Plan No. 1



Arrangement of Combination Cocks and Other Fittings—Plan No. 1

but for illuminating oils rotary or other hand-operated pumps should be provided to avoid the serious injury to oil and the resultant accidents that might occur through the failure of a lamp caused by the moisture in the air.

Small auxiliary air tanks or receivers are provided with

easily be modified to suit the requirements of an oil house under almost any conditions.

When it is possible to receive oils in tank cars, greater economy in handling will be effected by an arrangement of pipes to discharge the oil direct from the tank car to the storage tank in the basement.

A number of houses, one of which is shown in plan No. 2, using the same system and apparatus as outlined in plan No. 1, have been built and are in successful operation. This house is of a considerably larger capacity and shows the tanks lying horizontally and supported on concrete saddles, the oil being received from oil tank cars by gravity, as well as from barrels through filling boxes, if necessary.

The capacity of this house is 750 barrels of oil and provision is made to take care of waste and engineers' kits in a similar way to that shown in plan No. 1, but not repeated here. This house takes care of an assignment of 200 locomotives and a car repair yard of 240 standing room capacity.

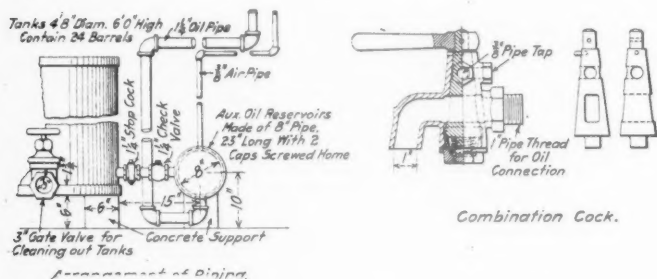
The amount of oil and the various kinds handled is as follows:

Item	Gallons.	Consumption
No. 4 Autoline		per month
150 Degrees	16,000	13,000 gallons
Car	4,200	3,000 gallons
No. 1 CTL	4,200	1,500 gallons
Signal	4,200	1,000 gallons
Air compressor	bbl. lots	100 gallons
Coach-Engine	4,200	2,100 gallons
Turbine	4,200	750 gallons
Transil	bbl. lots	25 gallons
Fuel	4,200	4,000 gallons
G. R. E.	bbl. lots	147 pounds

It will be noted that several kinds of oils are received in small barrel lots and are stored in the barrel, no provision being made in the way of tanks for such small quantities.

There are several details that it might be well to call to the attention of those interested.

While not shown in plan No. 1, it is understood that all

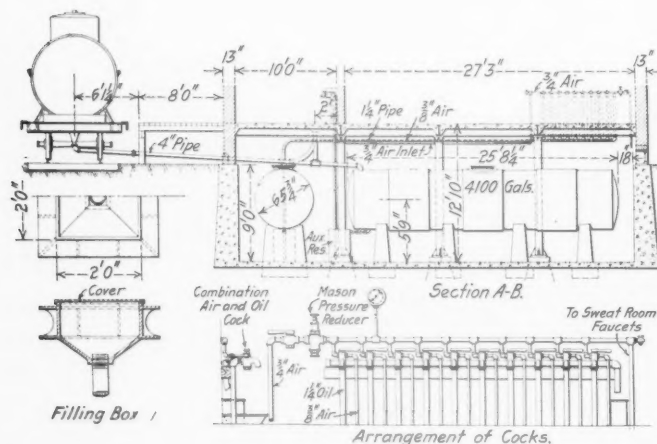


Combination Cock and Arrangement of Piping—Plan No. 1

tanks should have a vent, preferably in the manhole cover, of a 1-in. hole. Some recommend carrying the vent to the outside of the building through a 1-in. or 1 1/4-in. pipe. The writer thinks this an unnecessary expense, as all oil houses should be provided with ventilators in the roof or through the chimney, as shown in plan No. 1, except in cases of kerosene and gasoline, the latter at all times being stored outside of the building, preferably in a buried tank.

THE COMBINATION COCK

At each application of this combination air and oil cock there is an exhaust of more or less oil, depending on the speed used in operating the cock. This amounts to about



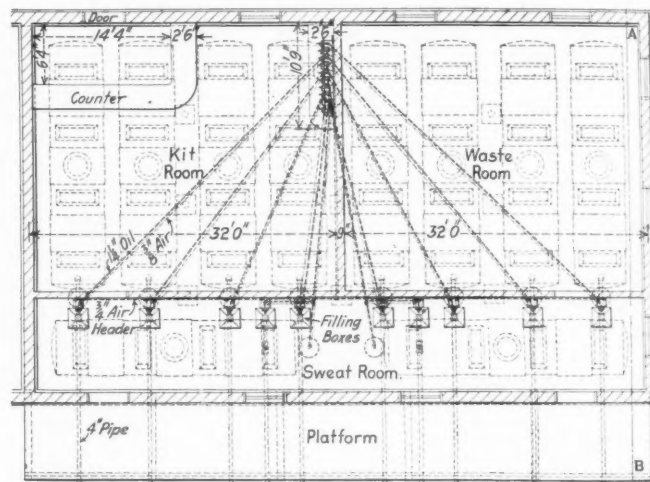
Cross Section of Oil House, Plan No. 2. Arrangement of Cocks and Filling Box

a tablespoonful of oil, the reclaiming of which is provided for by a 1 1/2-in. drip pipe located in the rear of the battery of cocks or faucets and long enough to receive the oil from the 3/8-in. exhaust outlet on each cock. This is outlined in

the arrangement of cocks, plan No. 2, which shows how the excess oil reaches the drip can.

FILLING BOXES

The filling boxes are located in the floor of the sweat room in front of and in line with the center of each large receiving tank and are used for the purpose of taking care of oil shipments in barrels, either in receiving or dispatching, the filling of barrels being done by a combination cock located immediately over each filling box. The excess, through spill-



Terminal Oil House Plan No. 2

ing over and from the combination cock, or what might otherwise be wasted oil, is taken care of by the funnel shaped filling box which allows this excess to return to the tank from which it came.

These filling boxes are set to project 1 1/2-in. above the floor level for the purpose of excluding sweepings and other foreign matter which might otherwise find its way into the storage tanks, also to better allow the barrel to rest upon them while filling or emptying, thus preventing the oil from running over the floor and being wasted.



Photo Copyright by Underwood & Underwood, N. Y.
The Port at Stockholm, Sweden

RAILROAD ADMINISTRATION NEWS

Director General Hines took his first vacation since he became connected with the Railroad Administration, during the month of September. He was away from Washington for the two weeks ending September 20.

MECHANICAL COMMITTEE MEETING

At a meeting of the Committee on Mechanical Standards last week a special committee consisting of A. W. Gibbs, H. L. Ingersoll and John Purcell was appointed to consider the elimination of angle cocks from the air brake train line. A report and recommendation will be made to the committee at its next meeting in November. The committee also made some minor changes in the proposed standard designs for caboose cars, which, as amended, will be submitted to W. T. Tyler, director of the Division of Operation, for final approval.

COST OF FREIGHT TRAIN AND LOCOMOTIVE SERVICE

The total cost of freight train service, including locomotive service, continues to show a steady decrease each month as compared with preceding months, although increases as compared with last year, according to the monthly report of the Operating Statistics Section. For the month of June it was 101.8 cents per 1,000 gross ton miles, as compared with 103.9 in May, 112.7 in April, 119.5 in March, and 126.5 in February. No comparison of this figure with last year is given. The cost of freight locomotive service per locomotive mile in June was 107.1 cents, as compared with 97.4 cents in June, 1918, an increase of 10 per cent, and as compared with 110.3 cents in May of this year. The cost of freight train service per train mile was 154.7 cents, as compared with 142.8 cents in June, 1918, an increase of 8.3 per cent, and as compared with 156.8 cents in May. All items of cost continue to show increases as compared with last year. The combined averages for all regions and the comparative figures for last year and for preceding months of this year are as follows:

	June					
	1919	1918	June, 1919	May, 1919	April, 1919	March, 1919
Cost of locomotive service per locomotive mile.....	107.1	97.4				
Locomotive repairs	36.1	31.1				
Enginehouse expenses	8.8	6.8				
Train engineers	19.6	18.5				
Locomotive fuel	39.1	38.1				
Other locomotive supplies.....	3.5	2.9				
Cost of train service per train mile.....	154.7	142.8				
Gross ton-miles.....	101.8	103.9	112.7	119.5	126.5	
Enginehouse expenses.....	51.1	43.7				
Locomotive repairs	44.6	43.9				
Locomotive fuel	4.0	3.4				
Other locomotive supplies.....	22.3	22.3				
Train engineers	25.6	25.3				
Trainmen	7.1	5.2				
Train supplies and expenses.....						
Cost of train service per 1,000 gross ton-miles	33.7	35.4	38.6	40.8	43.1	
Locomotive fuel	29.3	30.6	34.3	37.5	40.3	
Other locomotive supplies.....	2.6	2.6	2.9	3.1	3.4	
Enginehouse and trainmen.....	31.5	31.1	32.4	33.5	34.8	
Train supplies and expenses.....	4.7	4.2	4.4	4.6	4.8	

HOURS OF SHOP EMPLOYEES INCREASED TO NINE

The effect of the recent strikes of shop employees is plainly seen in the reports of bad order freight cars as of August 9, when the percentage of bad orders had increased to 9.3, although the strikes were not terminated until about a week later. On August 9 there were 144,000 cars requiring heavy repairs and 83,000 requiring light repairs. Since then the shop employees have been put on a nine hour a day basis. On August 2 the bad order cars were 8.5 per cent, as compared with 7.1 per cent on the corresponding date in 1918. About 135,000 required heavy repairs and 73,000 light repairs. A year ago the classification was not recorded. On July 26, the date of the last report preceding the strike, the percentage was 8.5 as com-

pared with 7.2 the year before, and 139,183 required heavy repairs and 68,922 light repairs, a total of 208,105. On that date 106 roads or 77.9 per cent had more than 4 per cent of their cars in bad order and 30 roads, or 22.1 per cent, had less than 4 per cent. Forty per cent of the bad orders were box cars and 25 per cent were gondolas.

The number of bad order cars increased during the spring months while traffic was light and while the Railroad Administration was exerting great pressure to effect economies. In February the hours of the mechanical forces were reduced from the war basis to eight hours a day and in March the forces were reduced. At that time there were 400,000 to 500,000 surplus freight cars. In the latter part of June, when traffic began to pick up and a large number of cars were automatically put in the bad order class by being assigned for grain service, orders were issued to increase the car repair forces, but the strike came before much headway had been made.

SHOP CRAFTS AUTHORIZE LEADERS TO CALL STRIKE

The railroad shop employees affiliated with the American Federation of Labor have voted 325,000 to 25,000 to authorize their officers to call a strike to enforce their original demands for a general increase in wages from 68 to 85 cents an hour rather than to accept the offer recently made to them by the President and Director General Hines of increases of from 4 to 7 cents an hour by way of readjustment. The vote places full authority in the hands of the officers; however, and they apparently decided to take what they can get while waiting for a reduction in the cost of living or an opportunity to renew their demands. Although they had once rejected the offer the officers entered into conferences with Director General Hines and his assistants in the Railroad Administration on September 5, prepared to accept the offer and to negotiate for the national agreement covering rules and working conditions which Mr. Hines had promised them before the negotiations were broken off on August 1 by the unauthorized strikes. Mr. Hines attended the conferences on Friday and Saturday and they were continued this week by his assistants after Mr. Hines had left for a vacation of about two weeks.

Director General Hines on September 4 addressed an ultimatum, similar to that issued in the case of the striking trainmen in California, regarding the local and unauthorized shop strikes on the New York Central at Depew, N. Y., on the Baltimore & Ohio at Cumberland, Md., and on the Chicago, Burlington & Quincy at Havelock, Neb., saying that unless the men returned to work not later than their regular reporting time on Saturday, September 6, they would be considered as having permanently left the service, their places would be filled and if they returned to the service later it would be only as new employees. This notice was conveyed in telegrams sent to the regional directors, stating that the chief executives of the shopmen's organizations had definitely instructed their men to return to work, directing that the federal managers post the telegrams conspicuously on bulletin boards and consider them as their instructions to proceed accordingly.

ORDERS OF REGIONAL DIRECTORS

Chicago Joint Agreement Between Brotherhoods.—Circular 88, of the Northwestern regional director, quotes rules of the Chicago Joint Agreement between the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, which are to be incorporated into existing schedules on railroads where such schedules exist and where they are not already included.

Repairs to New Freight Car Equipment.—The Southwestern regional director, in Order 232, states that when new freight car equipment built for the Railroad Ad-

ministration is placed in shop or on track shop for repairs all bolts should be gone over and nuts tightened to insure taking up all shrinkage that has taken place since the cars were built.

Automobile Cars—Safety Chains on End Doors.—Order 233 canceling Order 227 of the Southwestern regional director states that the Safety Section recommends that chains or some other suitable device be applied on automobile cars with end doors to prevent these doors opening further outward than the line of the side of the car, and suggests that all cars, regardless of ownership, be so equipped as rapidly as possible.

Accident Prevention Drives.—The Northwestern regional director, file 97-1-20, announces the National Railroad Accident Prevention Drive, from October 18 to 31, inclusive, and suggests that federal managers call a meeting of general officers to discuss plans for making this drive a success, the meeting preferably to be held in conjunction with the meeting of the General Safety Committee if the meeting of that committee is scheduled to be held in advance of October 1.

Fire Prevention—Smoking.—Supplement 11 to Circular 32 of the Northwestern regional director states that during 1918 there were reported to the Fire Loss and Property Protection section, 252 fires directly attributable to carelessness in smoking or the use of matches, with a total loss of \$159,629, and calls attention to the necessity for strict enforcement of the no smoking rule in wood working shops, paint shops, etc.

DIRT IN COAL*

BY L. J. JOFFRAY

General Fuel Inspector, Illinois Central

The ash content in coal varies widely in different localities and frequently there is considerable variation in the same locality under different conditions of mining and preparation. The normal amount of ash may be considered as that found in the face sample of the seam proper; the excess ash is that which is added to the coal from the roof or bottom in the process of mining and which is not eliminated before the coal leaves the mine.

Lump coal made over a 1¼-in. screen usually shows the normal per cent of ash, while the 1¼-in. screenings in most cases show one and one-half times the percentage of ash contained in the lump.

The ash content in screenings can be reduced nearly to that of the screened lump by the use of a jig gravity washer, with an ample water supply and a convenient place to deposit the refuse. However, the washing of screenings has been considered too expensive while the price of all coal was low, but since prices have gone 60 per cent and more higher, and will probably remain so, it may be well, and at the same time profitable, to eliminate the excess ash by washing in the vicinity of the mines, thereby saving the use of cars for and the long haul on inert material to points where coal is finally consumed, the cost of which would be about six mills per ton-mile.

The following table showing ash and B. t. u. content of coal from a bituminous mine in the central west district illustrates how the ash content of screenings can be reduced by washing:

	Ash, per cent	B. t. u.
Dry or unwashed screenings.....	22.61	8,895
Washed screenings	14.05	10,085
Lump	12.39	10,499

The excess ash in mine run and prepared sizes, made over an inch and a quarter screen, can easily be removed by hand by the miner at the working face when loading

into mine cars, or by having men or boys working on picking tables or belts while the coal is passing to the railroad car.

The performance of this work can be looked after by a regularly assigned fuel inspector. We are using a system of close inspection with suggestions to the mine superintendents on the ground while the coal is being loaded. As a result of this effort, the impurities removable by hand picking and based on actual carload tests have been reduced from an average of 2.733 per cent in the year 1911 to an average of 1.535 per cent in the year 1917, or a net reduction of 1.198 per cent which applied to a consumption of 4,000,000 tons of coal used annually represents 47,920 tons less ash, requiring the use of 958 fifty-ton cars to move same. The transportation cost of moving this excess ash an average distance of 266 miles, based on an "out of pocket" cost of five miles per net ton-mile, equals \$63,733.60 per annum. This, however, is but the lesser saving.

Taking the established estimate of increase in efficiency of 1½ per cent for each reduction of one per cent in ash, the saving from this source, i. e., increased evaporative efficiency, with coal at a delivered price of \$3.68 per ton equals \$264,518.40, or a total saving of \$328,252.00 per annum. What the measure of the economies following from reduced engine failures and reduction in enginehouse expense amount to are difficult of computation.

ELEMENTS OF ASH

The effective combustion of coal depends largely on the nature and per cent of impurities it contains, especially so if the ash has a tendency to clinker, which is dependent on the percentage of silica, iron and lime in its composition. Tables I and II give analyses of coal and ash, respectively, used in ten burning tests from ten different mines in Illinois and Indiana.

TABLE I—ANALYSES OF COALS

Test Num-ber	Moisture per cent	Volatile matter per cent	Fixed carbon per cent	Ash per cent	Sulphur per cent	B. t. u.	Clinker?
1	3.37	31.31	55.19	9.63	.64	12,325	No
2	6.02	30.00	53.50	10.30	1.30	12,136	No
3	4.61	31.35	54.05	10.00	1.19	12,368	No
4	2.92	33.10	51.25	12.73	2.96	12,389	Yes
5	4.99	39.22	43.99	11.80	4.43	11,768	Slightly
6	3.41	37.12	45.62	13.85	4.02	11,842	Yes
7	5.13	37.70	44.31	12.80	4.52	11,693	Yes
8	2.86	36.04	43.14	17.96	4.58	11,124	Yes
9	8.49	34.87	48.16	8.48	1.47	12,251	No
10	4.68	38.59	44.24	12.49	4.50	11,921	Yes

TABLE II—ANALYSES OF ASH

Test Num-ber	Sulphur (S) per cent	Silica Oxide (SiO ₂) per cent	Iron Oxide (Fe ₂ O ₃) per cent	Aluminium Oxide (Al ₂ O ₃) per cent	Calcium Oxide (Lime) (CaO) per cent	Magnesium Oxide (MgO) per cent	Color of ash
1	.64	59.0	3.1	31.0	5.6	1.3	White
2	1.30	55.2	8.3	26.6	7.3	1.3	White
3	1.19	56.1	8.1	27.2	5.4	.9	Light gray
4	2.96	45.4	25.3	16.9	11.6	.8	Reddish gray
5	4.43	49.1	32.2	13.5	4.5	1.4	Reddish gray
6	4.02	35.1	22.4	10.2	30.8	1.5	Reddish gray
7	4.52	43.3	24.1	9.0	19.9	1.2	Reddish gray
8	4.58	44.8	20.3	18.6	16.4	1.5	Reddish gray
9	1.47	45.8	20.2	28.3	5.4	0.0	White
10	4.50	27.1	52.3	14.1	4.4	1.2	Dark gray

Fusing tem. deg. F. 239 3227 2840 3416 3452 3882

Table I gives the usual proximate analyses of the coals. Table II gives analyses of the ash. By referring to the column showing the clinkering and non-clinkering coals and then making a review of the ash table, we observe that the coals with non-clinkering ash are low in both sulphur and lime. In burning they did not clinker in a dazzling white fire of an approximate temperature of 2,900 degrees F., while the ash in the clinkering coals fused at a fire-box temperature of approximately 2,200 degrees F., which indicates clearly that when the sulphur and lime content exist in high proportion to the silica, iron and aluminium oxides, it is the direct cause of the ash fusing at the lower temperature.

*Abstract of a paper presented before the convention of the International Fuel Association at Chicago, May 19-22, 1919.

The bottom line of Table II shows the fusing point of the sulphur and the different oxides. From this it will be seen that by taking each element separately the fusing point is at a higher temperature than is usually obtained in the furnace of a boiler. However, by combining these elements in proper proportion with the sulphur, fusion at a much lower temperature will take place.

The conditions of these ten experiments as to draught, etc., was identical in each case. However, I have since observed that either one of the coals containing the clinkering ash will give better results both as to combustion and reduction of slag in the ash by increasing the draught, which increases the flow of air through the fire bed and has a tendency to keep the temperature of the fire below the fusing point of the ash. Hence it is always good policy to assign the clinkering coals to a lower class of service, as switch engine, local freight, and other light runs. However, when considering the possibility of burning the low grade clinkering coals to profitable advantage, such should not be construed so as to minimize the responsibility of those who are assigned the duty of eliminating all impurities possible when the coal is being prepared at the mines.

SANTA FE TYPE LOCOMOTIVES FOR LIGHT TRACK

A group of three Santa Fe type locomotives has recently been completed by the Baldwin Locomotive Works for the Alabama & Vicksburg. These locomotives are to be used for heavy freight service and are designed to operate on rails weighing 75 lb. per yard and over. They are of special interest as they illustrate the suitability

three-inch tubes. The front end of the firebox crown is suspended on three rows of Baldwin expansion stays. The main frames are of annealed vanadium cast steel. The bolster of the front truck is suspended on heart shaped links. The rear truck is of the Delta type and is used in combination with the Commonwealth rear frame cradle.

The Walschaert valve motion is applied and is controlled by a type B Ragonnet power reverse gear. The piston heads are of steel and the packing rings are made of gun iron. The latter material is also used for the steam chest bushings and the valve packing rings.

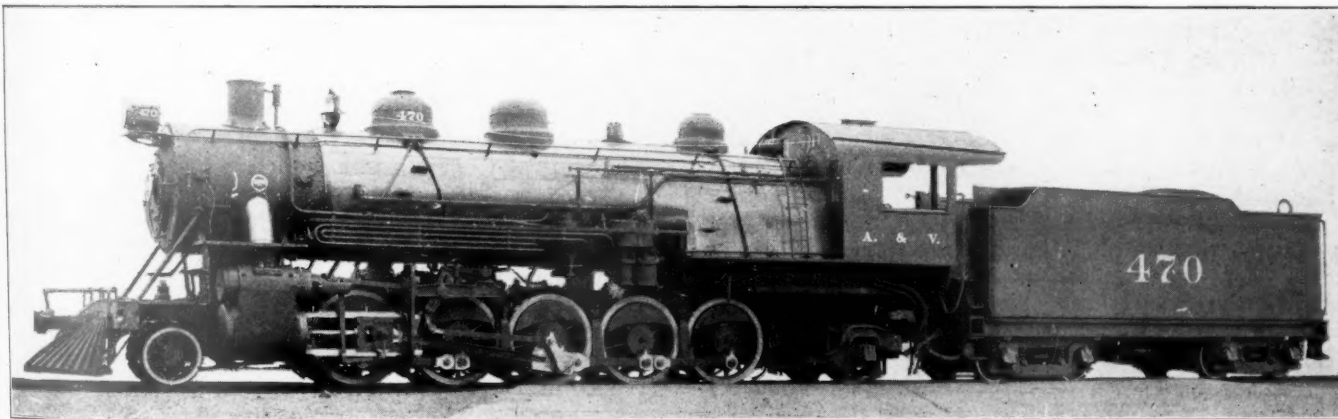
The main driving axles and the rear truck axle are of chrome vanadium steel quenched and tempered in accordance with A. S. T. M. specifications. All wearing brasses, including the crosshead gibs and driving wheel hub liners, are of phosphor bronze. The pedestal wedges and gibs are of brass. The firebox is equipped with a power operated fire-door.

General Data

Gage	4 ft. 8½ in.
Service	Heavy Freight
Fuel	Soft coal
Tractive effort	52,300 lb.
Weight in working order	274,715 lb.
Weight on drivers	218,390 lb.
Weight on leading truck	26,325 lb.
Weight on trailing truck	30,000 lb.
Weight of engine and tender in working order	440,700 lb.
Wheel base, driving	20 ft. 4 in.
Wheel base, total	37 ft. 2 in.
Wheel base, engine and tender	71 ft. 3¼ in.

Ratios

Weight on drivers ÷ tractive effort	4.2
Total weight ÷ tractive effort	5.2
Tractive effort × diam. drivers ÷ equivalent heating surface*	691.2
Equivalent heating surface* ÷ grate area	73.4
Firebox heating surface ÷ equivalent heating surface*, per cent.	6.0
Weight on drivers ÷ equivalent heating surface*	50.7
Total weight ÷ equivalent heating surface*	63.8
Volume both cylinders	18.5 cu. ft.



Alabama & Vicksburg 2-10-2 Type for Heavy Freight Service

of the Santa Fe type for heavy freight service on lines where the track conditions will not permit the use of motive power having high wheel loads.

As far as practicable, the detail parts of the Santa Fe type locomotives are designed to interchange with those of the Pacific and the Mikado type locomotives previously built for the same road.

The following table of dimensions will give the comparison between these locomotives and the Mikado type.

	Santa Fe type	Mikado type
Cylinder dimensions	26 in. by 28 in.	22 in. by 28 in.
Drivers, diameter	57 in.	57 in.
Steam pressure	185 lb.	200 lb.
Grate area	58.7 sq. ft.	46 sq. ft.
Water heating surface	3,278 sq. ft.	2,573 sq. ft.
Superheating surface	754 sq. ft.	561 sq. ft.
Weight on drivers	218,390 lb.	168,400 lb.
Weight, total engine	274,715 lb.	217,500 lb.
Tractive effort	52,300 lb.	40,400 lb.

The boiler is a straight top design with a fire tube superheater. A Gaines combustion chamber is applied in connection with a Security firebrick arch, which is supported on four

Equivalent heating surface* ÷ vol. cylinders	232.4
Grate area ÷ vol. cylinders	3.2

Cylinders

Kind	Simple
Diameter and stroke	26 in. by 28 in.

Valves

Kind	Piston
Diameter	14 in.

Wheels

Driving, diameter over tires	57 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 in. by 12 in.
Driving journals, others, diameter and length	10 in. by 12 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6 in. by 10 in.
Trailing truck wheels, diameter	40 in.
Trailing truck, journals	7½ in. by 12 in.

Boiler

Style	Straight
Working pressure	185 lb. per sq. in.
Outside diameter of first ring	75¼ in.
Firebox, length and width	148½ in. by 78¾ in.
Firebox plates, thickness	Sides and back ¾, crown ¾, tube ½
Firebox, water space	Front 5 in., sides and back, 4 in.
Flues, number and outside diameter	32—2 in.
Flues, number and outside diameter	215—5¾ in.
Tubes and flues, length	19 ft. 3 in.

Heating surface, tubes and flues.....	3021 sq. ft.
Heating surface, firebox, including arch tubes.....	257 sq. ft.
Heating surface, total.....	3,278 sq. ft.
Superheater heating surface.....	754 sq. ft.
Equivalent heating surface*.....	4,309 sq. ft.
Grate area.....	58.7 sq. ft.

Tender

Tank.....	Water bottom.....
Wheels, diameter.....	33 in.
Journals, diameter and length.....	6 in. by 11 in.
Water capacity.....	10,000 gal.
Coal capacity.....	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CERTAIN ESSENTIALS*

By EUGENE McAULIFFE

Manager, Fuel Conservation Section, United States Railroad Administration

I wish to today to say a few words on certain compelling features which, if attended to, will accomplish more in one year towards effecting fuel and operating economies than has been accomplished in the past five years. Briefly, the outstanding essentials of the railway fuel problem are:

Clean Coal.—Buy clean coal, get clean coal. There is not a coal contract in existence that does not suppose the delivery of the cleanest coal that the particular mine from which the purchase is made is capable of producing. Do not ask from the coal producer the impossible, but insist on the possible. Tests have proved that with coal containing 12.5 per cent of ash taken as 100 per cent the relative efficiency falls as the ash increases until coal with 40 per cent of ash marks a total lack of efficiency. At the mine face, or on the mine tippie, is the place to clean coal. The excess and removable non-combustible matter can be separated cheaper there than in the locomotive firebox. Let the producer do the cleaning, such is a proper part of the cost of production. I have found on a majority of roads an insufficient and frequently untrained inspection force. The roads which most need an inspection force are most lacking in this respect. Ninety-nine per cent of the coal operators, all that are worth considering, will appreciate the help that an intelligent inspection force can give them. Good inspection supposes many things, including contract, quality, weights, clean equipment and proper class of equipment.

Distorted Valve Motion.—The next cheapest thing we can do is to organize the work of establishing and maintaining a proper distribution of the steam made from the coal purchased. I commend to your attention the paper written by J. W. Hardy on fuel losses due to defective valve motion, then read the circular just issued and immediately proceed to carry out the simple recommendations therein contained.

Air Leaks in Locomotive Front Ends.—On August 1, 1918, the Fuel Conservation Section issued Circular No. 8 calling the attention of motive power men to the fuel losses that result from air leaks in locomotive front ends, particularly those that surround the steam pipes where they leave the front end. The recommendations contained in this circular were followed in some instances; in others, ignored. A locomotive suffering from front end leaks invariably fails unless her guardians have compromised with her cost of keep and earning power by choking the nozzle.

Distorted Draft Apparatus.—A limited survey of the interior of locomotive front ends can be easily made by looking down into the stack when the engine is cool, using a common flash light. This casual inspection, if made, will astonish many of you. Here, again, we lack organization and method. Distorted draft apparatus invariably indicates shiftlessness.

Stopped Up Flues, Grates and Ash Pans.—Another essential has been covered briefly by the recent Fuel Conservation Section circular dealing with stopped up flues and choked superheater unit tubes, choked air openings in grates, and

restricted air inlets in ash pans. An insufficient air opening in the ash pan represents a defect in design; the rest represents defects in execution. These conditions again result in the application of the well-known remedy, choking the exhaust nozzle, with the result that the engine struggles part or all the way over the division at the expense of the fuel bill, delaying the reduced tonnage handled, with corresponding delays to opposing trains which are side-tracked at meeting points to wait for the crippled engine.

The Superheater.—Another essential I wish to speak of relates to the proper maintenance and handling of what is the most substantial fuel saver ever put on the American locomotive, i. e., the superheater. The purpose of the superheater is to conserve fuel and water, and to increase the general efficiency of the locomotive. In some instances this result is obtained to the extent of 100 per cent, the measure of efficiency shading off in other cases until the apparatus is frequently not able to absorb the load of improper locomotive maintenance put on its shoulders. Certain engineers carry water levels so high as to transform the superheater into an evaporator, getting the train over the road at the expense of much fuel and a few additional tanks of water. We have found superheater units not only improperly installed, but poorly maintained, and often they are not tested with sufficient frequency to locate the steam leaks that occur in the front end when the engine is working. The Fuel Conservation Section recently issued a circular on superheater losses; they deserve your best attention.

Back Pressure Losses.—A condenser cannot be used on a locomotive, and the limitations that surround the locomotive necessitate a restricted exhaust in order that a sufficient rate of combustion can be maintained with a relatively small boiler, generating many hundreds of horsepower. Under the conditions that commonly obtain, of all the fuel that is used in the locomotive, only about six per cent is available for use in moving freight or passengers. Excess back pressure losses, therefore, apply against the six per cent saved for tractive purposes. Under the circumstances, why cripple the locomotive by choking the exhaust to offset lack of proper adjustment of draft apparatus, the closing of air leaks in front ends, the cleaning of tubes, superheater flues, etc.?

The Old Type of Locomotive.—Many of us began with the eight-wheel type of locomotive with low steam pressure and small firebox and grate area. These little engines had no fuel-saving devices, but they played their part in the greatest peaceful drama the world ever saw, the building of the Western Empire. Too many light locomotives have been scrapped in the past; instead they should have been modernized and kept in service suited to their capacity. In many instances locomotives too heavy for the job are employed to the detriment of train-mile costs and the permanent way. The fuel-saving attachments developed in recent years, with the exception of the compound air pump, only earn when the locomotive is moving, and it is very probable that improvements of the above character, if applied to the existing light locomotives now lacking them, would pay an equal or greater return than is being received from their application to the more modern locomotives. We frequently overlook the fact that the heavier types of locomotives, of which these devices are considered an essential part, make a lower average mileage than the lighter and, consequently, a more mobile type.

In conclusion, I wish to suggest the absolute importance of bringing every locomotive now in service, or that will be required for the service, up to the maximum standard of efficiency. I have been told that the work of applying superheaters and brick arches under order, and in some cases in stock has been held up on certain roads because of insufficient funds to apply them. This is unfortunate, and I trust the condition will be quickly remedied.

*Abstract of a paper presented at the convention of the International Railway Fuel Association at Chicago, May 19-22, 1919.

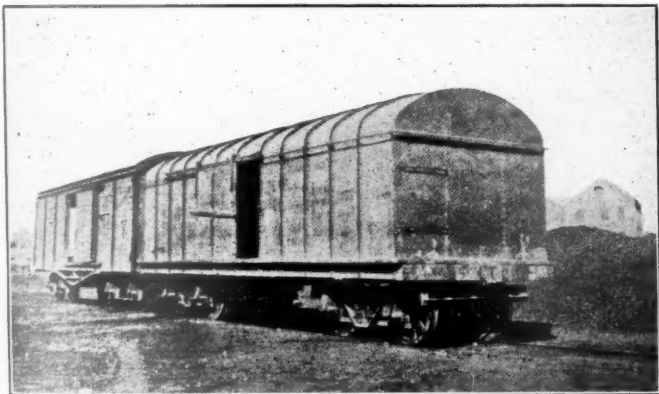
CAR DEPARTMENT

GENERAL CHARACTERISTICS OF CHINESE ROLLING STOCK*

One of the great needs of the Chinese government railways at present is a very considerable increase in freight cars and locomotives. The rolling stock per mile of line of 2,774 miles of Chinese railways, compares with several other countries as follows:

	Chinese Railways	Japan (1916)	Germany (1913)	U. S. (1916)
Number locomotives per mile.....	.18	.47	.77	.26
Number passenger cars per mile.....	.38	1.19	2.29	.45
Number of freight cars per mile.....	3.23	7.42	17.60	9.85

The initial equipment on all the lines (particularly those first constructed) is representative of the practices of the nations furnishing the loan funds. As a result, the Chinese railways today have, as a whole, a more miscellaneous assortment of equipment than any other equal mileage of



Box Car of Steel Construction Used on the Chinese Government Railways

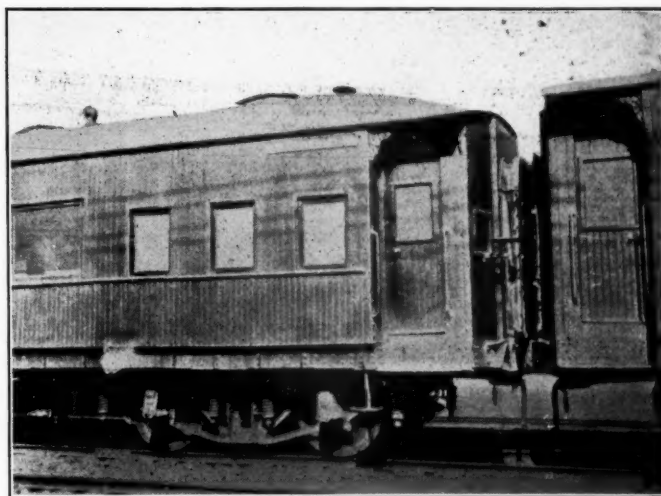
railways in the world. A considerable part of the rolling stock (particularly the locomotives and goods wagons first acquired) is light and of small carrying capacity. This was very unfortunate, for the reason that the railway business of China is not naturally a classified-goods business but rather the transportation of commodities, and this tendency, as the railways are extended and the traffic grows, will probably become more pronounced. Therefore, the advantage of freight cars of large capacity and heavy motive power, along the lines of American practice, is readily apparent. The character of the early rolling stock forms the explanation for the light design of the bridges, which will have to be corrected at much expense before the type of equipment demanded by this class of traffic can be used. The average tractive effort of all locomotives on the Chinese government railways is now approximately 21,000 lb., the average carrying capacity of all passenger cars is 67.5 persons per car, and the average carrying capacity of all freight cars is 50,350 lb. In connection with the locomotives, however, it should be mentioned that on the Peking-Suiyuan line, which is equipped with 60 American locomotives out

of a total of 66, the average tractive effort of all locomotives is about 30,000 lb., which has the effect of reducing the average of all locomotives on the other lines to about 18,700 lb.

It is also surprising to find the small amount of freight equipment that is equipped with air brakes. In one instance this lack of power brakes is limiting the coal traffic that one of the roads can handle during the winter when it should be handling the maximum tonnage. The Peking-Suiyuan line, on account of the heavy grades over the West Hills, is well equipped with air brakes on all its equipment, and the lack of brakes on the other lines is an additional restriction on the free interchange of traffic between this line and the other lines not so equipped. The Janney-Penn couple is used very generally on all the lines, and probably its use is more nearly universal than that of any other one device on the Chinese government-railways.

TRAIN BRAKES

When used, air brakes are usually of the Westinghouse design of the nation furnishing the equipment. It is not usual for other nations to put as much braking on the locomotive and tenders as is the American practice. The passenger equipment, as a rule, is well equipped with air brakes, but no air train signals are in use on any of the lines. The freight equipment is only partly equipped with air brakes. Most of the lines depend on hand brakes. As



Dining Car on the Peking-Mukden Railway, Showing Vestibule Without Steps

a rule, every fifth or sixth car is equipped with a small shelter; the train is arranged for two of these to come together and the braking is done by hand.

PASSENGER EQUIPMENT

Sleepers and first-class passenger cars are usually of the compartment-corridor type. The Peking-Mukden, Tientsin-Pukow, Peking-Hankow, and Shanghai-Nanking

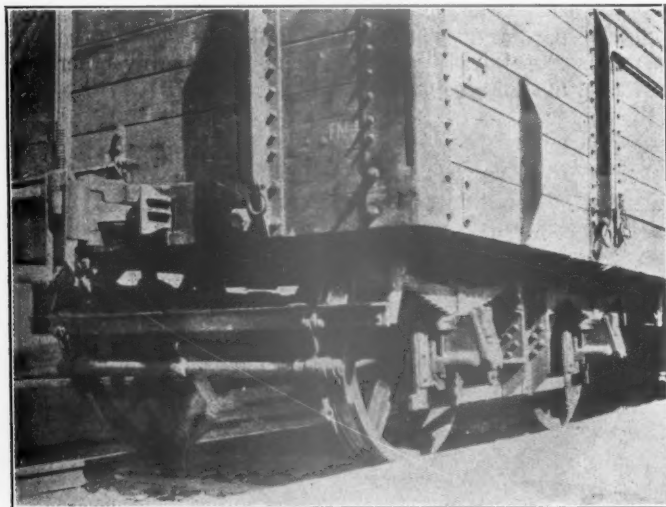
*From Special Agents Series, Report No. 80, Bureau of Foreign and Domestic Commerce, Department of Commerce, by Frank Rhea.

own and operate their own sleeping cars, and on all these lines the same equipment performs the service of first-class passenger car and sleeping car. These are the only lines running sleeping cars, and they, as well as the Peking-Suiyuan, own and operate their own dining cars.

The second-class equipment is usually provided with serviceable wooden seats and the third-class sometimes with cheaper seats, but frequently with benches; in some instances, particularly when the coolie class is carried, no seats of any kind are provided. One of the illustrations shows the vestibules and one end of a diner on the Peking-Mukden Railway. It will be noticed that there are no steps to the vestibule platforms. This requires all station platforms to be built with only a low step from the vestibule. In no instance noted by the writer was any passenger equipment heated from the locomotive, the only hose connection being the one for air brakes.

FREIGHT CARS

The initial equipment on the first Chinese railways (except that purchased from America) was of small capacity, and much of it can best be termed goods wagons, but the tendency has steadily been toward equipment of greater capacity until today practically all new freight cars are



Type of Freight Car Truck Used on the Peking-Hankow Railway; Note the Vertical Plane Coupler on the End of the Car

67,200 lb., or 30 long tons capacity. All the Chinese railways use the British practice of a loading gauge. The size of equipment is somewhat restricted, and it would appear very desirable to increase this in the case of new railway construction, to permit of the utilization of larger equipment as the traffic develops, particularly if this development should be along commodity lines.

A freight-car truck in general use on the Peking-Hankow line is shown in one of the illustrations and another shows a typical box car used on most of the Chinese railways. It was stated that this type of construction is quite satisfactory on all the lines north of the Yangtze River, but that the deterioration of the sheet iron on the southern lines, such as the Shanghai-Nanking, is quite serious. With the scarcity of lumber in China, however, this design would seem to have much merit.

CAR WHEELS

The British have used their typical steel-tired wheel, usually with cast-steel centers and of 42 in. diameter, on passenger and freight cars of all classes and capacities. The Germans have done the same with a wheel 100 cm. (39.37) in. in diameter. On the American equipment, particularly freight cars, most of the wheels have been of the

regular chilled cast-iron type and, according to the information obtainable, have given satisfactory results. One of the suggestions that the writer heard mentioned a number of times was the desirability of the Chinese government railways adopting such a standard size of car wheel as can be satisfactorily produced with a chilled cast-iron wheel and then making their own supply of wheels. This seems practicable, taking into account the supply of iron ore and fuel, together with the fact that many of the Chinese shop laborers make good foundry molders.

SERVICE CARS

On account of the large amount of cheap labor in all parts of China, very little attention has been given to labor-saving service cars, and the present equipment is almost entirely confined to that which involves the use of hand labor for all classes of work. One of the most generally seen pieces of special equipment is the small derrick car, sometimes taking the form of a small locomotive crane. Steam shovels and steam wrecking cars are practically never seen.

VACUUM BRAKES

In an article by A. Fuhr published in the *Annalen für Gewerbe und Bauwesen*, and abstracted in the *Technical Supplement* of the Review of the Foreign Press, a discussion of the Clayton-Hardy vacuum brake vs. the automatic or pressure brake brings out some interesting features. It may be said that the railways in Europe are giving a great deal of consideration to the adoption of some good type of continuous brakes to their freight trains, in order that they may be handled more expeditiously.

A. Fuhr, in commenting on the vacuum brakes, states that one of the inherent difficulties of this brake is that of the low working pressure which does not generally amount to more than 14 in. of mercury, while pressure brakes operates with pressure six to ten times greater. The low pressure of the vacuum brake requires heavy and bulky machinery where the system is used. For instance, one pressure brake with a 12-in. diameter cylinder and an air receiver of 2 cu. ft. capacity, was found to produce the same effect as two vacuum brakes each with a 21-in. cylinder and an air receiver of 19 cu. ft. capacity. Modern steel cars weighing 30 to 35 tons when empty require three to four such vacuum brakes. For instance the mechanism on a car with four axles fitted with Westinghouse pressure brake weighs 116 lb. including the transmission rod and return spring, while on a car with two vacuum brakes, with 21 in. diameter cylinders, levers, plunger blocks, supports, and other working parts it weighs half a ton, or 1,120 lb. The greater weight, therefore, means more expense.

Another disadvantage of the vacuum system is that leakage in the pipe system causes a constant inflow of air charged with dust, soot, oil, moisture, etc. This occurs regularly when the locomotive is changed, and the valves and fittings therefore become choked and work badly, while the pressure brake remains clean much longer, as any grit or moisture which may be drawn in through the air-compressor is deposited in the main-air receiver and does not reach the brake valves. The number of hose pipes required with the vacuum brake is greater than that required for the pressure brake, as each passenger car fitted with reversing vacuum brakes requires five separate pipes, which must all be reinforced against collapse, while the pressure brake only needs one.

The low pressure is disadvantageous, as it is all but impossible to keep the large bore pipes and fittings tight. They are considered satisfactory according to Austrian regulations when the fall of pressure does not exceed $2\frac{1}{2}$ in. of mercury per minute. The standard vacuum of 14 in. of mercury is

thus reduced to 7 in. in $2\frac{1}{2}$ minutes; that is to say, the vacuum brake is very sensitive to the slightest extra leakage, while the pressure brake is still quite effective if the air pressure from some exceptional reason should sink to half the standard pressure.

Expansion of air in the vacuum brake also produces a low temperature, and there is consequently a tendency to freeze up and likelihood of disturbance to traffic, especially in northern latitudes. During the severe winter 1916-1917 this tendency became almost a calamity in Sweden, as there were almost daily delays of 8 to 10 hours in the Lulea-Stockholm train service, exclusively due to the vacuum brake. It was found necessary on the iron ore line Lulea, Riksgrand-

sen-Narvic to remove the vacuum brakes and refit with pressure brakes.

A. Fuhr further states that the alleged greater simplicity of the vacuum brake has not been borne out in practice, owing to the cocks at the couplings, which are necessary for vacuum brakes, being troublesome, repairs difficult, readjustments frequent, and that the distance in which a train can be stopped is approximately the same as with a pressure brake.

According to tests carried out on the Prussian lines, the steam consumption of the vacuum brake is very considerable, and at least twice as high as that for similar trains fitted with pressure brakes.

ILLUMINATION OF THE RAILWAY CAR*

Improved Methods of Regulating Electric Lighting
Equipment; New Developments Keep Down Costs

BY E. WANAMAKER

Electrical Engineer, Chicago, Rock Island & Pacific

A RESUME of the history of railway train lighting compiled from the records available shows that great strides have been made in the art since the days of the first experiments. To one Thomas Dixon, driver of the coach "Experiment" on the Stockton and Darlington Railway, in England, in 1825, is given credit for having first used artificial light in a railway car. He was a man of generous motives, and having in mind the comfort and convenience of his passengers on dark winter nights he placed a penny candle on a table, also provided by him, in the center of the car. From this humble beginning railway train lighting has grown and kept pace with the development of illumination in other fields and with the growth of other transportation facilities. Today, electric systems for lighting cars cost hundreds of dollars per car and a large number of employees are necessary to provide and maintain this service.

A review of the progress made in developing car lighting shows it is divided into periods of approximately 25 years for each illuminant used. The period of candle light lasted from 1825 to 1850, when oil lights were introduced. Oil lighting in turn gave away to gas in 1875, and gas continued to be the most generally used illuminant until about 1900, when the application of electricity to car lighting began to receive wide attention by railroads, and in this country at least is now the system generally preferred for new equipment.

STRAIGHT STORAGE

The earliest electric system of which we have a record was a straight storage system used on the London, Brighton and South Coast railway in 1881. Primary batteries were also tried in France in 1885 on cars operating between Paris and Brussels. At about this same time straight storage lighting was tried by the Pennsylvania Railroad and the Boston & Albany in the United States, and on the first-mentioned road this was for many years the electric system most used. Such a system requires an expensive charging plant at each terminal. Its main disadvantage is the limited time which a car can be kept in service without being held for charging and the liability of light failure due to batteries becoming discharged when trains are delayed or held from regular charging terminals. Another disadvantage arises from the fact that cars equipped with this system cannot be oper-

ated on branch lines or at isolated points where charging facilities are not available.

THE "HEAD-END" SYSTEM

"Head-end" equipment was first tried in 1887, when it was installed by the Pullman Palace Car Company in one of its composite cars operating between Jersey City, N. J., and St. Augustine, Fla., in the Atlantic Coast Line Special. In the same year, the Pennsylvania Limited was similarly equipped, and in 1888 the Chicago, Milwaukee & St. Paul also had a train equipped in this manner.

The head-end system was first tried out with a generator in the baggage car and no batteries, but due to frequent light failures caused by the trains being parted and the locomotives being cut off at division points, it was found necessary to place batteries on the first and last cars of each train so that if a train was parted to cut out or cut in cars, each section would have light. In some cases batteries were applied to each car. This greatly increased the time that lights could be depended upon in case of the generator unit being out of service and also made it possible for each car to have light when cut out.

Various means are used to control the lamp voltage and battery charging rates. Each road seems to have developed a system to meet conditions as they exist on its particular lines, which has resulted in several different schemes of wiring, battery charging and operation, all of which give results more or less satisfactory.

An axle-driven head-end system has been designed to furnish power for lighting the train and charging the batteries from a single unit, the batteries being distributed throughout the train, as for instance, one set in the baggage car, one in the observation or dining car, and sometimes one in the middle of the train. The number of batteries used and their location are governed by local conditions.

While this system is not liable to light failures, due to lack of steam, it has the same disadvantages as the steam driven, head-end systems, namely, that cars not equipped with batteries are dark when cut out of a train, that they are not interchangeable when operating on foreign lines, and are liable to light failure due to small battery capacity when trains are delayed or tied up. It would, therefore, seem that this system is unsatisfactory for universal operation.

For suburban and branch line service, the straight head-end system without any auxiliary battery has been found

*Abstract of a paper presented at the opening meeting of the Western Railway Club, Chicago, on September 15.

very economical and successful. The present practice for this class of service is to mount the turbo-generator on the locomotive in a manner similar to that used for mounting headlight turbines, the generator being of sufficient capacity to furnish current for the headlight and cab lamps and the maximum number of cars usually assigned to this class of service.

A three-wire system of wiring and standard train line connectors are used for making connections between cars and locomotive. No doubt, in the near future this system will be used more extensively on branch lines due to the low first cost, low maintenance cost, and the ease with which the installation can be made to existing power and rolling stock. All cars are similarly wired, and the number of cars in a train is only limited to the capacity of the turbo-generator and train line wires. Low first cost results from the simplicity of the car wiring system, which includes only a train line circuit and one lamp circuit connected to it with a fused knife switch in a steel switch box.

Credit for the earliest attempt at lighting a train with axle-driven equipment is given to the London Brighton and South Coast Railway, on which a crude system was tried out in 1883. Since that date development has gone on unceasingly, and individual axle-driven systems are now most generally used for train illumination in this country.

After years of test only one form of transmission for driving the generator is in general use. Various forms of belts and direct drive have been used, but due to the variable relation between the axle pulley and the armature pulley, and the climatic conditions, the rubber belt up to the present has been found to meet the requirements most economically.

Some of the first generators were suspended from the car body, others were mounted on the truck. Much time has been spent in improving generator suspensions, which has resulted in the elimination of many wearing parts, thus simplifying and reducing the maintenance costs.

The body hung suspension is favorable to the maintenance of the generator and possibly to the car truck. With it the belt is considerably longer than with the truck type suspension. Therefore, the belt life must be increased in the same proportion as the length is increased in order to keep the belt cost per car mile the same. Much is claimed for both types of suspensions, each having its possibilities, the conditions under which they operate and the condition in which they are maintained being important factors.

An important point in connection with axle lighting is the proper application of axle pulleys. If they are not properly applied the belt life will be short and the maintenance cost high. In a great many cases axle pulleys are applied to eccentric axles which should have been turned to insure a perfect pulley seat. In some cases pulleys are applied with improper pulley bushings. Eccentric pulleys and small belt clearances over the brake beam comprise two of the main causes of short belt life. Far-sighted mechanical men on some roads have made provisions for successful and economical operation of the belt drive by using turned axles or by turning a pulley seat on hammered axles to insure concentric pulleys. Also in some cases special brake rigging is being used to give ample belt clearance.

MAINTENANCE

To secure good service from the entire equipment at a low operating cost a standardized systematic method of maintenance must be used. With the present design of equipments the belt cost constitutes the second largest single item of expense. Records should be kept from which individual belt mileage can be computed. From these records any car using an excessive number of belts will be noted and steps taken to correct any defects found.

At the periodical shopping of cars the electrical equipment

should be thoroughly overhauled and placed in a first-class condition, all worn parts being removed and defects corrected. If this is done thoroughly heavy repairs will seldom be found necessary between the shopping periods.

A systematic inspection of the generator and suspension should be made each trip to see that all parts are in good condition. Once each year the generator should be dismantled and all parts thoroughly cleaned, fields and armature painted with insulating varnish and new grease applied to ball bearings.

TRAIN-LINE FACILITIES AND FIXTURES

On the majority of railroads, facilities are provided for making connections from car to car so as to provide light in a defective one. It is the almost unanimous opinion of car-lighting engineers that with the present equipment, facilities for train-line connections are essential if light failures are to be avoided, connectors being especially desirable for the protection of mail cars.

The tendency in fixtures is toward simplicity of design to harmonize with the interior construction of the car. Center-deck lighting seems to be generally preferred with a sufficient number of units, properly shaded, to give uniform distribution. Enamel finishes the same color as the car walls or ceiling at the point where the fixtures are located are most used, but there is reason for believing that in time the roads will again prefer metal finishes, as these, when properly applied to fixtures of pleasing design, help to improve the interior appearance of the car. In recent years statuary bronze has been the metal finish most used.

A matter of great importance is that of careful selection and design upon which depends effectiveness of the installation, both as regards light distribution and appearance. These various questions involve a study of intrinsic brilliancy, intensity, distribution and color.

BATTERIES

There are two distinct types of storage battery in use in car lighting service at the present time, the lead acid battery and the nickel-iron alkaline battery. Of the lead batteries there are two general types of plates, the Plante and the Faure. For a given output, the Plante is more costly, more bulky, and heavier than the equivalent pasted plate type. Thus far this type is more durable and better able to withstand the operating conditions incidental to car-lighting service. It is the type most used in car-lighting service, but some car-lighting engineers claim that the advantage it has had over the Faure type is decreasing with the increased cost of labor and improved methods for battery protection. The nickel-iron alkaline battery is of comparatively recent development and is radically different from the lead acid battery. It is light in weight and mechanically rugged.

The cost of maintaining batteries constitutes the largest single item of expense in the maintenance of car-lighting equipment, and the entire development of regulators or apparatus for battery protection while the car is enroute has been made with a view of prolonging the life and reducing the cost of maintenance. However, good standard practice for handling batteries is also essential if this cost is to be kept within reasonable limits.

With the present design and construction, the cleaning period is comparatively short. By a change in design the same capacity could be maintained and yet the space for sediment could possibly be doubled, thus greatly prolonging the cleaning period, insofar as it is based on this particular feature. Some manufacturers are now endeavoring to produce a battery which will not have to be removed from the car for cleaning during the life of the positive element, or at least to prolong the period of time between the cleaning far in excess of present practice.

The control of the generator output while the car is en-

route has offered one of the most difficult problems to be overcome, since the life of battery and lamps depends to a large extent upon regulation.

Without the proper protection, the battery life may be only a third of what it should be. In a similar manner also the cost of maintaining the generator depends upon the regulation.

REGULATORS

The duties of the regulator for car-lighting service are: (1) To connect the battery to the generator at the minimum speed and voltage for which the machine is designed to operate and to disconnect the battery when the speed and voltage fall slightly below the first mentioned value; (2) to provide a variable voltage to charge the battery at the proper rate, which is determined by the state of charge, and at the same time carry the lamp load, in the event it is turned on, up to the capacity of the generator; (3) when the battery has attained a full state of charge, the regulating means must prevent further charge thereafter, leaving the generator capable of supplying current to lamps or other translating devices; (4) to provide constant voltage on lamps while the car is in motion or at rest.

There are two types of regulators in general use, designed with the view to meet these requirements: First, ampere hour meter control; second, potential control. The first mentioned method charges the battery by starting at a high rate, which is gradually modified to a predetermined lower rate, and when a predetermined number of ampere hours have been put into the battery as indicated by the meter, the potential is reduced by the regulator sufficiently to prevent further charge. With this method it is necessary, for proper battery protection, to maintain the ampere hour meter in step with the state of charge of the battery.

It is apparent that the proper battery protection depends not only on the proper functioning of the meter itself, but also upon the battery remaining in normal condition in order that the battery and meter may remain in step with each other. Owing to battery characteristics and operating conditions, the meter does not always indicate the true state of charge.

In the second method of charging heretofore referred to as "potential control," inherent characteristics of the battery are taken advantage of to govern the charging rate, and when the battery has attained a full state of charge, to prevent further charge thereafter. With most potential control equipments, a current limit feature is embodied with the potential regulator to hold the maximum current to a value consistent with the generator capacity.

Many forms of potential control equipment have been placed on the market, most of which operate at potentials such that in the course of charging, the battery is caused to gas. In 1913 and 1914, efforts were made by the Rock Island to operate equipment at a maximum voltage of 2.3 volts per cell. At the beginning the experiment was found to be a failure, as in many instances cars on most runs arrived at terminals with the batteries in a decidedly discharged state. There were, however, cars in fast main-line service on which the batteries remained in a full state of charge and at the same time were not being overcharged, the batteries requiring flushing on an average of about every six months. This was encouraging and led to investigations which developed that the failures were not due to the fact that the low voltage would not keep the batteries charged, but resulted from the fact that this voltage of 2.3 volts per cell was not attained except at very high train speeds. In one test covering a period of five hours, the equipment maintained full voltage and load for less than 10 per cent of the running time. On the face of the evidence it looked as though a larger generator designed to give full voltage and load at a lower train speed would be required, but fortunately after

further investigation it was found that with certain refinements in the regulating device, a lower cut-in speed could be secured.

A test made with an improved regulator with the same generator that was used on the previous test and over the same run, showed the following comparison:

Full load—Old regulator—35 miles an hour.

Full load—Improved regulator—24 miles an hour.

Full load time in 5 hours—Old regulator—10 per cent.

Full load time in 5 hours—Improved regulator—41 per cent.

In this case the capacity of the unit was increased 300 per cent.

The net results realized from the use of the improved regulator are increased capacity of the unit due to obtaining generator output at low train speed, and increased battery life, which is brought about by the following:

(A) The work imposed upon the battery of furnishing energy for the lights is greatly reduced by the increased working time of generator, and also by the fact that the current for the lights is supplied by the generator, and not by the battery, at all times after the generator cuts in.

(B) The battery is charged at the proper rate to prevent gassing and overheating with the attendant ill effects.

(C) The battery is protected from overcharge and the forming away of the reserve lead in the battery elements.

Even though only a part of the Rock Island equipments have been improved, the cost of operation and maintenance per car per month has not increased, in spite of the increased cost of labor and material, and a very large part of the savings is attributed to the better protection provided for the battery.



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A Howitzer on an American Work Train at Kypeselga in Russia

DRAFT GEAR DESIGN AND MAINTENANCE

General Foremen in Convention Discuss Spring and Friction Draft Gears and Their Function

IN addition to many other important questions, the subject of design and maintenance of draft gear was considered at the fifteenth convention of the International Railway General Foremen's Association, held in Chicago on September 2-5. Several excellent papers on the subject were read, abstracts of which are given below.

DRAFT GEARS

BY J. W. WOMBLE

An ideal draft gear should have not only a suitable friction capacity and travel, but it should also be positive in its nature, simple in design, of few parts, readily applied and removed from the car, and applicable to the standard pocket space. It should be so constructed that a buffing shock greater than sufficient to close the gear will not be apt to injure it in any way, that is, after the gear becomes solid the blow should be transmitted to the draft sills without injuring the draft gear itself, or without it being necessary for the horn of the coupler to go home against the striking plate in order to relieve the shock.

The design of the gear should be such that the frictional load is not dependent upon the speed at which the gear is closed nor should it be dependent on the internal parts of the gear being carefully machined or requiring considerable care in fitting them together. It should be so made that it could be applied and removed from the car and the repair parts substituted, if necessary, by ordinary labor. It ought also to have sufficient area of friction faces to bring the pressure per square inch to a figure that will insure it having a satisfactory life in service.

The term friction draft gear is somewhat of a misnomer, as it is both draft and buffing gear, the latter being undoubtedly its most important function. If the draft and buffing features could be divided and considered separately, no doubt better results could be obtained. Unfortunately, this is not feasible, and the draft gear must necessarily take both of these requirements into consideration.

On this account it is advisable that a draft gear have a low capacity at the start of its movement in order to get the best results in pulling service. This only utilizes a small part of the capacity of the gear, and the capacity at that part of the travel should make it possible to easily start the train. After about the first inch of travel, the capacity should rise quite rapidly, but uniformly, to its ultimate limit in order to absorb a large part of the buffing blow without causing too much shock to the draft sills.

COMMITTEE REPORT

The committee recommends that: The committee's data in the future be obtained from both laboratory and actual service tests. That a large proportion of gears installed be stencilled with date applied and notice to employees to report conditions and all facts whenever they are removed, this information to be used in connection with actual service tests. That draft gears be inspected and maintained at intervals depending on the kind of service. That poor gears be gradually eliminated and good gears be confined to as few as possible. That the General Foremen's Association express its willingness to aid the supply men in developing the best possible protection to the car against shock. That so far as possible the length, width and height of gears be brought to a standard so as to eliminate the different sizes of coupler yokes now required without sacrificing the gear efficiency.

The report is signed by W. W. Scott (D. L. & W.) and C. F. Bauman (C. & N. W.).

MAINTAINING DRAFT GEARS

BY L. A. NORTH,

Superintendent of Shop, Illinois Central, Burnside, Ill.

In taking up the subject of draft gears, it is with the object of bringing to the attention of the general foreman, particularly the general foreman of the locomotive department, the necessity of spending more time in the car department to obtain such knowledge of car department matters as will be of benefit to them when they are advanced to the next step in the ranks, that of master mechanic.

They should thoroughly familiarize themselves with all matters pertaining to the repairs to cars, particularly the draft rigging. From observation, the logical place to examine the draft gear and the results derived from the application of the different designs of draft gears, is the repair track and the scrap pile. The damage caused from shock and rebound, due to defective draft gear, runs into millions of dollars every year. No matter what make of gear is applied to a car, unless the gear is maintained in working order, it will not properly function nor perform the duties that the designer or builder claim for it. There are a number of different friction draft gears on the market today which under test will demonstrate to the observer that the gear will perform just what the manufacturer claims for it, viz.: absorb the shock and decrease the rebound, but, as stated before, unless sufficient attention is paid to the maintenance and upkeep of this gear, the money expended is money thrown away.

A visit to the repair track will show end sills and draft arms broken and bent, center sills buckled up and car underrigging in a generally dilapidated condition. In looking for the cause as the usual thing we find the draft gear worn out, inoperative and parts missing, so that the casual observer's first opinion would be that the draft gear did not perform the duties that it was designed for.

Some railroads have made it a practice to drop the draft gear when the car is placed on the repair track and make a thorough examination of the different parts of the gears to determine what parts need renewing or repairing, with the result that the gear has a chance to function properly and perform the work that it was originally designed for.

With the introduction of the heavy capacity cars, it has become more necessary than ever to pay particular attention to the draft rigging. Hump service is much harder than ordinary switching service on draft gear and has made it necessary to fit cars engaged in this service with substantial draft rigging and draft gear that will properly take care of and absorb the shock and rebound which comes from this service. A visit to any of the hump yards will further verify this statement and will illustrate the necessity of properly providing a substantial draft gear and maintaining it in good repair at all times.

DRAFT GEARS

BY C. F. BAUMAN

Chicago & North Western, Winona, Minn.

The draft gear is a cushioning device applied to cars, and so situated that the rear end of the coupler rests against it in such a way that when the couplers meet one another in the case of cars colliding, the draft gear has a limited movement or travel under resistance, according to its

capacity, so as to soften or cushion the shock on the cars and their lading. It is also secured to the coupler by a yoke so as to use the cushioning effect to prevent the pulling shocks from doing damage. I think a better name for the draft gear would be the car protector.

My study of broken or damaged cars leads me to believe that if a draft gear of sufficient capacity to care for the buffing shocks is used it will be ample to care for the pulling forces, as I cannot call to mind a case of damage due to pulling unless the parts were first damaged and weakened by the buffing shocks, excepting very rare cases of coupler yokes breaking under pulling strains where the yokes were made of the old light section of 1 in. by 4 in. bars, and even of lighter section. The new standard yoke section of 1 1/4 in. by 5 in. has put a stop to this failure and there are very few of the old light sections of yokes in use now. I would strongly recommend replacing these weak yokes with the newer standard as early as possible. The cost would be slight, compared with the saving effected.

BUFFING SHOCKS

If a study is made of the car failures as they pass over the repair shop tracks and the piles of scrap material collected from the repairs to the cars, the necessity for improved draft gear is very plain. Couplers and their parts are found broken, bent and upset, due to the shocks they receive. If a draft gear could be found to assist the car in absorbing these shocks, couplers would wear out instead of being discarded for the defects mentioned above. This would result in a great saving to the railroads.

The following damage to freight cars are common sights to all of us who have to supervise repairs to cars: Ends of cars pushed out by the lading, broken draft sills, broken draft arms, broken center plates, broken center pins, broken and bent steel center sills, broken body and truck bolsters, broken oil boxes where the car has not been derailed. The sides, roofs and superstructures of box, stock and other cars of the house type construction are also often found in a racked and loose condition, all of which is caused by the parts mentioned being forced to do the work of the draft gear. If the shocks were kept out of the cars all these items would have to wear out, which would take a long time. Applying a draft gear that will make it possible to move the cars from point to point without this destructive effect, or that will at least make a material reduction in it, would be an economical measure.

TYPES OF DRAFT GEAR

There are a large number of different types of draft gears in service, a few of which are enumerated below: One of the old designs uses a single spring 8 in. by 7 7/8 in., with a front and rear follower, connected to the coupler with a yoke. The spring has a capacity of 30,000 lb. with a travel of 1 3/4 in. The cushioning value of this assembly is very low. It has no absorbing capacity, as all springs simply store up the energy until the pressure is taken from them, when it is returned with the same force that was required to close them. There are very few cars in service that are equipped with this single spring type. There are also spring draft gears made of two springs, some in tandem and others in twin assembly. They are made up generally of two different sizes of springs. The smaller type consists of two 6 1/2 in. by 8 in. springs, having a combined capacity of 38,000 lb. and a travel of 1 3/4 in. The capacity and travel are both insufficient to protect the cars and the use of this gear should be discontinued. Other designs are the tandem and twin spring gears made up of two 8 in. by 7 7/8 in. springs having a combined capacity of 60,000 lb. and a travel of 1 3/4 in. The recoil of these heavier springs is such that it is nearing the danger line in its reaction in long trains so that to use more spring capacity would in my opinion be a mistake.

A large number of different types of friction draft gears are in use, some of which are doing good work. There are a few essential features of the friction gears which I will comment on. Since a large committee of prominent mechanical railroad men appointed to design the 100,000 cars purchased by the administration decided to use friction draft gear, also in view of the fact that practically all new car specifications include friction gear, and considering the many thousands of old cars that have been reinforced with steel underframes or metal draft arms equipped with friction draft gear, the spring gear may be eliminated and the discussion confined to the friction type.

DRAFT GEAR SPECIFICATIONS

While the committee performed excellent work in preparing the specifications and designs for the 100,000 freight cars for the Railroad Administration, and this paper should not be considered as criticising in the least sense, in my opinion there are some features of the draft gear question that could have been arranged so as to give the draft gear manufacturers a better chance to build to meet the conditions. For instance, five different makes are named as being satisfactory, but they are required to be interchangeable without changes in the car, so that in case of failure any one of the five kinds could be used to replace the defective one.

This would be ideal if it is granted that this application is perfection in draft gear design, but it is doubtful whether the draft gear manufacturers are willing to admit this. In fact, the manufacturer of one of the five gears used on these cars has several thousand cars equipped with a gear not confined to the spacing and travel specified for the government cars that will furnish double the protection to cars that it is possible to get with a gear travel of 2 3/4 in. They have given highly satisfactory service for several years and have passed the experimental stage.

One good point in the interchangeability of the gears is that in the course of time it should be possible to learn the relative service value of these five types, and get nearer to a standard by discarding the short lived ones; however, the demands on the draft gear change from year to year so that new developments in draft gear design may be looked for as the demands increase.

INCREASE IN CAR LOADED WEIGHTS

It is only a short time since the 80,000 lb. capacity car, which would weigh about 125,000 lb. on rails when loaded, was the heavy type. This was followed by the 100,000 lb. capacity car weighing 150,000 lb. on rails when loaded. Next came the 70-ton or 140,000 lb. capacity car which loaded weighed 200,000 lb. The 90-ton or 180,000 lb. capacity car came next, with a total loaded weight of 250,000 lb. The next heavy capacity car to make its appearance is the 120-ton or 240,000 lb. capacity car with a loaded weight of over 300,000 lb. When it is understood that these increases in rail loads per car all came into use during the last 15 or 18 years, and the wide difference in the amount of energy developed by these different weights moving at two or three miles per hour, the need for improved draft gear will be clear to all. Hence, I believe it would be a wise move to give the draft gear manufacturers more to say as to the space required in which to apply the device instead of confining them to 12 7/8 in. between the draft sills and 24 5/8 in. between the faces of the draft lugs.

CAPACITY DEFINED

The Railroad Administration specifications for draft gears call for a minimum capacity of 150,000 lb. with a maximum travel of 2 3/4 in. Stating capacity in pounds is misleading, as it only gives the final closing pressure, and it is possible to have the first 2 1/2 in. travel of the device with a capacity limited to 20,000, or 25,000 lb., and the last 1/4 in. movement might require a pressure of more

than 150,000 lb. to close the device. This would make a very poor draft gear for destroying shocks, as the first $2\frac{1}{2}$ in. travel would offer very little resistance to the forces and the last $\frac{1}{4}$ in. would not have time in which to act.

To make the capacity question clear, the Mechanical Committee of the United States Railway Administration gave the following definition of a 150,000 lb. capacity draft gear. It is the sense of this committee that a 150,000 lb. draft gear should be defined as one that will sustain a drop of 16 in. (including the travel of the gear) of a 9,000 lb. weight without shearing the rivets of one or both lugs, which are to be secured to suitable supporting members by nine $\frac{1}{2}$ in. rivets of .15 carbon or under, driven in $9/16$ in. drilled holes. This definition clears the question as it expresses the capacity in foot pounds, which is the correct unit to use, as in order for the gear to stand this drop without shearing the rivets it must offer a high resistance throughout its entire travel. This test requires the gear to have a capacity of 12,000 ft. lb.

This specification could easily be raised to 18,000 ft. lb. developed with the 9,000 lb. drop hammer. A gear that will develop 18,000 ft. lb. capacity, resting on a solid foundation, will show an increase of $66\frac{2}{3}$ per cent when secured to a rolling foundation such as a car, and would, therefore, be equal to 30,000 ft. lb. when applied to the car.

GEAR TRAVEL

The question of coupler or draft gear travel is of great importance, as the capacity of the gears can be increased or decreased as the travel is increased or decreased. The Railroad Administration's Car Committee in regulating the gear movement, specified that the maximum travel should be $2\frac{3}{4}$ in. It would be better if this regulation was changed to make $2\frac{3}{4}$ in. the minimum instead of the maximum. This dimension has so much to do with draft gear capacity that a committee of one car man, one air brake man and one operating man appointed to investigate and report back to this association the maximum amount of travel that could be allowed would be a step in the right direction. I am sure that this dimension can be increased.

INSPECTION AND ADJUSTMENT

The draft gears should be applied to the cars in such a way that their different parts can be readily seen and inspected by the men who are assigned to this work. Some are applied so that it is almost impossible to inspect them. Manufacturers should give more attention to this feature. If possible, the gears should be equipped with some practical and quick means of adjustment to take up the wear.

DRAFT GEAR INVESTIGATION

Some of the draft gear manufacturers have especially equipped laboratories for demonstrating purposes and some of them have made exhaustive tests not only of the draft gears but of couplers protected from the shock by the use of different gears, also sills of different weights per foot and of sills having the center line of draft different distances off from the center line of the draft channels, the results of which prove conclusively the cause of many failures in car design. The manufacturers are to be commended for carrying on this research work. If a car user is having trouble with any part of a car that is due to the shocks it receives in handling, these companies will duplicate that section of the car and destroy it in the laboratory, furnishing readings of the work so that the best remedy can be applied.

MAINTENANCE OF DRAFT GEAR

It is only recently that I have been impressed with the importance of keeping the draft gear repaired so that it will be in condition to perform its whole duty at all times. It must be remembered that a car having a good high

capacity draft gear colliding with a car having a low or weak gear helps out the car with the weak gear as the amount of protection that each car gets is the sum or combined value of the two. Every car turned away from the repair track with a good draft gear helps every other car it comes in contact with.

The forces applied to cars when they collide, up to the closing point of the gear can only equal the pressure required to push it closed or solid, but if double the energy required to close the gear is applied, this multiplies the pressure on the car by ten. For example, if two cars equipped with 60,000 lb. capacity draft gears should collide with a force that would just close the gears the pressure on the car would be 60,000 lb., but if the colliding forces are doubled the pressure on the car would raise to 600,000 lb., which in most cases would damage one or both of the cars so as to send them to the shops.

With these facts before us, I am convinced that no car should be allowed to leave the shop tracks until the draft gear is put in condition to do all the work that it is constructed to perform. By keeping the draft gear repaired, damaged cars will be reduced, thus effecting a saving and resulting in more efficient equipment. A concerted move along this line, I am convinced, will surprise all of us. The improvement cannot all be made at one shop, as this would create a congestion of defective cars, but let everybody start and all roads will be on a better footing very quickly.

I would recommend discarding the low capacity gears and substituting the better types as fast as possible. The cost of changing would soon be returned by increased car efficiency. I am of the opinion that where cars are repaired in large numbers a special crew of men in charge of a competent leader should be assigned to draft gear maintenance. The men in charge should become familiar with the different makes of draft gear so as to intelligently maintain them.

When draft gears are new or have been repaired the date of application or repairs should be stenciled on the draft sill where it could be plainly seen by the inspectors. At the expiration of three years (this may be changed to a longer period as soon as experience proves it to be good practice), the car or cars should be shopped for another draft gear overhauling. In case of a car being found on a foreign line with the date showing that the three-year period had expired, the road having the car should be obliged to shop it and overhaul the draft gear, billing the owner for the cost of the work. Improper repairs by foreign lines should be penalized by the cancellation of their bill. These few rules worked out more in detail and put into effect will reduce the bad order cars much quicker and in a more permanent way than increasing the number of car repair men and continuing to overlook the draft gear until the car damage forces it out of service for extensive repairs. Keeping the draft gear in shape would cost only a few cents and would save large expenditures for broken parts on account of the draft gear being neglected.

DISCUSSION

There was some difference of opinion as to the advisability of inspecting draft gears at regular intervals. J. H. Hott (A. T. & S. F.) objected to the periodical overhauling upon the grounds that it would have a tendency to cause lax inspection. L. A. North (I. C.) contended that a thorough inspection is necessary to insure that the gears are in serviceable condition. The advantage of draft gears of high capacity was generally recognized by the members. M. H. Westbrook (Grand Trunk) brought out the decrease in the ultimate strength of the draft members which results from locating the center line of the buffing and pulling stresses off the center line of the sills. The usual construction of setting the center line of the gear 2 in. from the center line of the draft members decreases the strength 40 per cent.



CAR INSPECTORS AND FOREMEN MEET

Discussion of the Working of the Rules of Interchange
and Changes Proposed by Arbitration Committee

THE nineteenth convention of the Chief Interchange Car Inspectors' and Car Foremen's Association met at the Planters Hotel, St. Louis, Mo., with W. J. Stoll, chief interchange inspector at Toledo, Ohio, presiding. The first session was opened with prayer by Captain Arthur Andrews of the Salvation Army, and the association was welcomed to the city by L. McDaniel, prosecuting attorney, whose address was responded to by T. J. O'Donnell.

PRESIDENT'S ADDRESS

In his address as president of the association, Mr. Stoll spoke in part as follows: The discussion of the M. C. B. rules and other matters pertaining to the construction and maintenance of cars is an important question and one which requires sound judgment and executive ability. The changes in the M. C. B. rules of interchange which take effect October 1, while not numerous, are quite important. The rules now in effect have not as yet been discussed by this association and I hope the members will take advantage of this opportunity to discuss them. I would also call attention to the fact that the loading rules have been rearranged and a discussion of them would be interesting and beneficial, as many cars are being improperly loaded. This association might well recommend that shippers should be furnished with copies of the loading rules. Because of the conditions which have been brought about by the war, such as pooling certain portions of the equipment, routing cars away from home where material was not available to make proper repairs, insufficient help, etc., it is necessary for this association to put forth its best effort to remedy conditions.

The report of the secretary-treasurer was read; it showed the total membership to be 508 and a satisfactory balance in the treasury.

DISCUSSION OF RULES OF INTERCHANGE

At the session on the afternoon of September 23 the discussion of the Rules of Interchange was begun. An abstract

of the discussion which followed the reading of the rules is given below:

Rule No. 2—Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge.

T. J. O'Donnell (Buffalo): I should like to ask what constitutes a serviceable empty car?

E. Pendleton (C. & A.): My interpretation is that a serviceable car is one that is suitable for any commodity.

Mr. O'Donnell: Should no cars be offered in interchange with defects though they require only light repairs?

F. C. Schultz (Chicago): I believe that in order to expedite traffic minor defects should be ignored.

Mr. O'Donnell: How would you handle coal cars with hopper doors not in serviceable condition?

Mr. Schultz: The repairs should be made by the receiving line.

G. Lynch (Cleveland): A car that must be sent to the repair track is not a serviceable car and the receiving line can refuse it or accept it, as it chooses.

T. J. O'Donnell: I consider that under present conditions it is necessary for the joint inspector to specify where the cars are to be repaired and distribute the bad orders among the various roads.

J. J. Gainey (Southern): I agree with Mr. O'Donnell in his interpretation of Circular No. 37.

F. Trapnell (Kansas City): We have received instructions from the Railroad Administration to regard as serviceable any car that requires less than 20 man hours to put it in condition for any commodity, and we have been working under this interpretation.

F. C. Schultz: It is necessary that we do whatever the local conditions demand to move the traffic.

T. J. O'Donnell: There should be some general ruling which could be applied regardless of the shop facilities at the interchange point.

J. J. Gainey: I believe that all cars having defects that

can be repaired on the light repair track should be accepted in interchange.

G. Lynch: The rules make a very definite distinction between the handling of loaded and empty cars. Loaded cars must be accepted by the receiving line, and run, repaired or transferred. On the other hand the empty cars can be rejected if not in safe and serviceable condition. This rule has made it easy for roads that originate a great deal of traffic to get cars off their lines while roads that offer a great many empty cars to connections have suffered from the accumulation of bad order cars which they were unable to dispose of without repairing them.

In an effort to secure an agreement as to the meaning of the rules it was moved that a car which must be placed on the repair track was not a serviceable car within the meaning of the rule. This motion was lost. A second motion stating that a car requiring not over 20 man-hours' work should be considered serviceable was also lost. A motion was made that the exceptions in Rule 2, paragraph *f*, should govern the acceptance of empty as well as loaded cars, but this motion also was rejected. The discussion showed that there was a wide diversity of practice in different sections of the country which was due in part to lack of uniformity in the orders issued by the Regional Directors. A committee was appointed to consider the matter further and present a report to the convention.

CHANGES RECOMMENDED BY THE ARBITRATION COMMITTEE

After the prolonged discussion on Rule 2, the association proceeded to consider the changes in the rules as recommended in the report of the Arbitration Committee presented at the 1919 convention.

Rule 32—(Delivering line responsible) Damage to any car (including cars on ferries or floats) if caused by (a) Derailment, (b) Cornering, (c) Sideswiping, (d) Collision or impact other than that occurring in regular switching, (e) Handling of cars with broken or missing couplers, or couplers out of place, (f) Colliding with or shoving over bumping post or other fixed obstruction, (g) Shifting of loads from other cars, (h) Overloading, (i) Explosion, (j) Collapsing buildings or other structures on right of way, (k) Unconcealed fire damage, (l) Flood, (m) Storm where car is derailed or destroyed, (n) Failure to close hopper or drop doors before moving car.

F. C. Schultz: The rules now in force have made it possible for roads to break up cars in switching and yet hold the owners responsible for the damage if the trucks were not derailed. I think the new rule will be an improvement as it will change this situation.

H. W. L. Porth (Swift & Co.): The intent of the changes is to clarify the meaning of the indefinite term "wreck." The judgment of the inspector will still enter, however, in determining what constitutes regular switching.

G. Lynch: The terms "collision," "impact" and "regular switching" are still indefinite and even the new rule will be hard to interpret. In case of missing material the car owner will no doubt contend that the parts have been stolen while the handling line will assert that they have been lost in fair service.

J. P. Carney (Michigan Central): I believe the changes are intended to put the responsibility for damage to weak equipment on the car owner.

F. H. Hanson (N. Y. C. West): I move that it is the sense of this meeting that if cars are damaged or broken in two the owner is to be held responsible for the damage if the trucks are not derailed and the car is not cornered or sideswiped. (The motion was put to a vote and carried.)

Rule 33—Owners will be responsible for the expense of repairs to safety appliances where not involved with other

delivering line damage, except damage to running boards on tank cars when sideswiped or cornered.

A. Herbst (N. Y. C. West): In the past a running board on tank cars had been considered a part of the safety appliances and the owners had been held responsible for damage if no other part of the car was involved. The Arbitration Committee, however, ruled that the running boards on tank cars cannot be damaged in fair usage and this rule has been amended to conform with that interpretation.

H. W. L. Porth: Safety appliances are often damaged when no other injury is done to the car and for that reason it hardly seems proper to hold the owner responsible.

Rule 66—(Owners responsible) Periodical repacking of journal boxes, regardless of the responsibility of delivering company for change of wheels, journal boxes or journal bearings. No charge shall be made for repacking unless all boxes are repacked. No charge shall be made if the repacking is done within nine months from date stenciled on the car. If car bears no stenciling showing date of previous repacking, all journals may be repacked if necessary and charged for.

(a) All journal boxes shall be repacked with properly prepared packing (new or renovated) at least once every 12 months, at which time all packing will be removed from the boxes and the boxes cleaned; dust guards to be renewed when wheels are changed.

(b) The date and place (railroad and station) where the work is done must be stenciled on the car body near the body bolster at diagonal corners in one inch figures and letters, using the same station initial that is used for air brake stencil.

(c) This work to be done as far as possible when cars are on repair track undergoing heavy repairs. Cars which have not had boxes repacked within nine months will have all boxes repacked and the record stenciled as above.

(d) This does not contemplate any change in the intermediate packing of boxes when it is necessary to do so. No change should be made in the stenciling unless all boxes are repacked.

J. J. Gainey (Southern): At the present time repacking of journal boxes is often done by removing the waste from the box, shaking out the dirt and short fibers and then replacing it. Such practices should be discontinued as they do not comply with the requirements of the rules.

The opinion was expressed by several members that periodical repacking of journal boxes would improve the operating conditions and effect a large saving. It was suggested that improper repacking could be eliminated by requiring the work to be done only at stations which are equipped with apparatus for reclaiming oil and waste.

Rule 88—In order that repairs of owners' defects may be expedited as fully as possible foreign or private line cars may be repaired by the handling line by using material from their own stock instead of ordering material from the car owner as prescribed by Rule 122 in which event the repairing line must issue its defect card for the labor only of correcting such improper repairs and defect card should be so marked.

In case of delivering line defects, defect card shall be issued for both labor and material for correcting the improper repairs.

F. C. Schultz: I believe it is advisable for the railroads to return private line cars to the owners for repairs as the average railroad repair track is not equipped to make proper repairs to these special types of cars.

F. Trapnell: There has been some criticism of the private car owners because of the fact that these companies often removed parts applied by the railroads after the car was returned to the owner. This inspection is necessary to insure that insulation in refrigerator cars, or other essential parts, have been properly applied.

H. W. L. Porth: It has been our experience that in most cases cars are returned when in need of repairs and the private car lines in general encourage this practice as they prefer to do the work themselves.

[At the time of going to press the convention was still in session, making the publication of a complete account of the proceedings impossible in this issue. The account of the remaining sessions will appear in a later issue.—EDITOR.]

BAD ORDER COAL CAR SITUATION

Producers Complain of Car Shortage; Conditions
Not Serious, Says Railroad Administration

THE relation of the bad order car to the production and transportation of coal, and the impending possibility of a coal shortage, was discussed recently before the Senate committee investigating the coal situation. The situation, so far as it is affected by the repair of cars, as outlined by Frank McManamy, assistant director of the Division of Operation of the Railroad Administration, appears to be well in hand and is not serious. He says in his statements to the Senate committee during the first week in September that cars can be furnished in sufficient numbers to meet the requirements of the coal producers or other shippers if the demand becomes urgent.

That this optimistic view is not shared by the coal producers is indicated by the statements of John Callahan, traffic manager of the National Coal Association, in his testimony before the Senate committee late in the month of August.

TRANSPORTATION IS INSUFFICIENT

The Railroad Administration is not furnishing enough transportation to insure production and shipment of sufficient bituminous coal to meet the requirements of the nation this year, stated Mr. Callahan.

"Car shortages caused the coal mines to fail to produce 5,900,000 tons of coal during the weeks ending August 2 and August 9," Mr. Callahan said. "This is sufficient coal to supply the requirements of the state of New Jersey for ten months. The difficulty today is a transportation deficiency and not a car shortage alone. Coal is one of the few commodities which cannot wait on transportation. It is physically impossible in many instances to bring coal to the surface and store it. Moreover, the proper place to store coal is at the point of consumption, where it will be available when required for use. Railroad cars must be ready when the coal is brought out of the ground.

"Many mines are idle today on account of no cars. Two hundred and eighty-five mines were idle because of car shortage in one West Virginia district during the week ended July 26. This was before the shop men's strike. Ninety-seven mines in this district failed to go to work in one day while many others only worked part time that day.

"The total bituminous coal lost through lack of railroad cars at the mines from the week ending June 7 to the week ending August 9, inclusive, was 12,251,762 tons, distributed by weeks as follows—June 7, 338,996; June 14, 655,190; June 21, 936,662; June 28, 644,149; July 5, 385,485; July 12, 428,359; July 19, 1,146,075; July 26, 1,764,264; August 2, 2,311,402; August 9, 3,591,180. This means 245,000 cars, or 7,000 train loads. This is more than six months' supply for all of the New England states; and this loss occurred in 10 weeks only.

"Since July 12, this shortage has been increasing by leaps and bounds. These figures are based on the United States Geological Survey reports, which indicate that whereas for the week ended July 19, where Director General Hines chose to close his recent report to the Senate, the loss on account

of car shortage was 7.4 per cent of full time output, the loss on August 9 was 22.5 per cent; this in the face of statements by the Railroad Administration to the effect that conditions are not now normal. In other words, the loss because of no cars at mines has trebled in three weeks, and is now on a parity with the ordinary shortage during severe winter months when the railroads are handicapped by congestions and engine failures.

"The director general points out that 37,000 new cars have been built, of which 17,000 have been put in service. If all of these 37,000 cars had been in service during the week of August 9 there would still be a shortage of 34,000 cars during that one week alone; but these cars are not yet in service and they are going into service very slowly. The director general states they are being stencilled and lettered and placed in service. He does not say how rapidly. In one instance recently where 2,000 of these cars were being lettered, the work was being done at the rate of 10 cars per day; on this basis, more than seven months would be necessary to place this one batch of 2,000 cars in service."

Mr. Callahan said that the movement of traffic is not adequate to the demands of coal to-day, and presented a table indicating that the average miles per car per day of all cars during 1915 was 24.4 miles. "The mileage per car per day for all cars in 1916," he continued, "was 26.9 miles. It declined in 1917 to 26.4 miles per day, and in 1918 it was 24.9 miles per day, but during the first six months of 1919, the average miles per car per day for all cars declined to 21.5 miles. This means a much lower mileage on coal than the average figures shown. If all traffic is moving slower, it is natural to suppose that coal moves much more slowly."

Mr. Callahan also introduced charts showing bad order coal cars by weeks from April 5 to July 19, and indicating that whereas there were 66,192 coal cars in bad order on April 5, on July 5 there were 105,295 of such cars requiring repairs, a rise in the percentage from 6.5 to 10.4 per cent of the total coal cars in the country. He also stated that "while the Railroad Administration statements recently set forth that there were 208,531 bad order cars at the time Mr. Hines's report was written (August 14) and while the director general stated that 'a large number of cars awaiting repairs are held for only light repairs which can be speedily applied' the facts are there were 135,895 cars requiring heavy repairs, and 72,636 cars requiring light repairs at the middle of July. This figure includes all cars and it is assumed that there are relatively as many coal cars requiring heavy repairs as other cars requiring heavy repairs." At the time to which reference is made 47 per cent of these 208,531 cars, or 98,139 cars were coal cars in bad order; and that on August 2, there were still 96,758 of these coal cars to be repaired.

"There are proportionately more coal cars in bad order to-day than closed cars," said Mr. Callahan. "Of a total of 1,183,490 closed cars, 95,928 or 8.1 per cent were in bad order on July 12, as compared with 98,139 bad order coal cars, out of a total of such cars of 974,547 or 10.1 per cent coal cars in bad order. Repairs to coal cars are being neglected through

preference to other cars. Moreover a figure of 10 per cent of coal car ownership in shop is abnormal. There should not be to exceed 5 per cent of the total number of coal cars in shop under ordinary good railroad management.

"COUNTRY FULL OF BAD ORDER CARS"

"The country is full of bad order cars. They impede the movement of freight through railroad yards in certain districts and are backing up the current of traffic. Moreover 8 to 10 per cent of the 62,000 locomotives owned by the railroads under federal control are now in the shop for classified repairs. These 5,500 or more engines, according to indications, will be needed quite early this winter. They could be used now in avoiding blocking coal mines with loaded cars. If these engines are not repaired at once, they may, when required for use, be in just the same condition so many cars are in today."

Mr. Callahan also quoted some correspondence with the Railroad Administration in which Mr. Hines said:

"There appears to be quite a disposition on the part of coal operators to exaggerate the argument about car shortage. I hope this disposition will not be persisted in because necessarily if the situation should be habitually exaggerated we would have to take issue with the claims thus made. It would be unfortunate for the Railroad Administration and the coal operators to get into a controversy on this subject because the controversy would tend to encourage people who are postponing the purchase of coal to feel that the coal operators are not justified in urging the purchase of coal. Naturally we prefer to see the purchase of coal expedited so it can be handled before the fall and hence we prefer not to say anything which will tend to encourage purchasers to hold off. Yet we could not remain quiescent under repeated assertions exaggerating the car shortage situation and incorrectly stating the policy of the Railroad Administration as to utilizing and repairing its equipment.

"What I would like very much to do is to get the practical co-operation of the coal operators in notifying us of any serious car shortages that exist in specific regions. Of course these matters are reported through our regular channels and are supervised accordingly, but a systematic and accurate check of the matter from the standpoint of the coal operators would be an additional safeguard of which we would gladly avail ourselves. Specific information along these lines conveyed to us will help us to handle satisfactorily a situation of common interest."

MC MANAMY DESCRIBES BAD ORDER CAR SITUATION

Mr. McManamy discussed the bad order car situation, saying the number of such cars is high at present but that the action which was taken by the Railroad Administration two months ago and which is still being diligently followed will, in his opinion, be sufficient to meet the demand for coal cars unless it reaches abnormal proportions, in which event the difficulty will be due not so much to car shortage as to the terminal facilities.

In July, 1918, Mr. McManamy said, 14.9 per cent of the locomotives were out of service for repairs and 798 were stored in serviceable condition. In January, 1919, there were 16.9 per cent out of service for repairs and 1,582 stored; in April, 18.4 per cent were out of service and 4,604 stored; in July, 17.9 per cent were out of service and 3,668 stored. Therefore, he said, the general condition of the locomotives today is better than at any time during federal operation or during the three years before and there is no ground for apprehension. There will be sufficient motive power to handle all the business offered to the maximum capacity of the terminals.

With respect to freight cars, Mr. McManamy said, the situation is somewhat different. On July 1, 1918, there were

167,403 bad order cars, or 7.1 per cent. The force of shopmen was then at its maximum and was working 70 hours a week. In December the number of bad order cars had been reduced to 130,506, or 5.4 per cent. After the armistice the hours were reduced from 10 a day for 7 days a week to 9 hours and 6 days a week and on December 9 to 8 hours a day. This was fully justified, he said, by the prospective decrease in business and was necessary both because of the severe strain under which the employees had been working and because of the importance of reducing maintenance costs by reducing the amounts paid for punitive overtime. The decrease in business was sufficient to make it possible to maintain the low percentage of bad order cars up to March, at which time it was 5.2 per cent, which for the country at large, Mr. McManamy said, is an almost ideal condition. The necessity for further economy on account of expenditures for maintenance of equipment as compared with the test period made it seem advisable to make further reductions in car department forces and this was done by furloughing men at many points and by further reducing the car department hours. As a result the number of bad order cars began to increase in April and until it reached 8.7 per cent in July, a total of 215,953.

With the increase in business the shop forces were increased, first by increasing the work on the box cars to meet the early grain movement, and before the grain movement became heavy sufficient cars were provided to handle it as promptly as elevator capacity and terminal facilities would permit. Meanwhile, Mr. McManamy said, the low coal shipments could not be charged to the Railroad Administration because they were due to no market. Anticipating an increase in production the Railroad Administration on June 19 issued instructions to increase car repair forces and this was followed on June 27 by instructions that wherever the demand for coal cars made it necessary cars requiring light repairs should be given preferential attention. This was followed on August 16 by instructions to increase the hours of the car department forces to nine a day on all roads where the number of bad order cars was sufficient to keep the men profitably employed or where work could be furnished from connecting lines without excessive empty mileage, also to give special attention to grain cars, coal cars and refrigerator cars in sections where they would be most needed.

This action was begun, Mr. McManamy said, at a time when the loss of coal capacity was 41.4 per cent, of which 26.2 was on account of no market and but 3 per cent on account of car shortage. The effect had already become apparent in a reduction of 8,414 in the number of bad order cars and of 5,741 in the number of bad order coal cars. The number of employees was increased about 8,000 and their hours to nine a day, making an increase of 12½ to 15 per cent in the number of hours worked.

"The increase in bad order cars," Mr. McManamy continued, "is not at all due to a slowing up of the repair program. It is to a substantial extent due to the fact that since the close of the war the railroads are endeavoring to get their cars in better condition and are therefore sending cars to the repair tracks which at any time in the past four years would have been continued in service without repairs. They are also holding cars for heavy repairs which at any time in the past four years would have been put in service with comparatively light repairs and which, if the demand for cars becomes sufficiently urgent, can again be returned to service with comparatively light repairs."

"The strike also interfered seriously with the car repair program, but I think we can reduce the number of bad order cars very substantially in the next two months unless we have some unforeseen labor troubles—and I do not look for them."

Mr. McManamy also testified that 68,598 of the 100,000

cars ordered by the Railroad Administration have been built, of which 51,428 are in service and 17,170 in storage waiting to be stenciled, which is being done at the rate of 700 a day. The balance of about 31,400 cars is being turned out at the rate of 220 per day and includes 10,658 double sheath box cars, 12,075 single sheath box cars, 3,562 50-ton gondolas, 949 hoppers, 1,826 low side gondolas and 2,332 70-ton hoppers.

That there is reason to believe that the car shortage has reached considerable proportions is shown by the action of the Railroad Administration in the matter of hours of labor in car repair work. Although the number of cars repaired in May and June, 1919, was fully up to the normal number of cars repaired, the Railroad Administration gave instructions on June 20, 1919, that all car forces be increased to the full standard measure of 48 hours per week and that additional shifts be worked where the additional employees could be obtained and where they could be economically used. The showing naturally to be expected from the putting into effect of these instructions was hampered in July by the intervention of practically a double holiday, and, of course, was temporarily prevented in August by the strikes of a large number of shop employees. Conditions having now been restored to normal, it is expected that these instructions will promptly show a most favorable result. Further than this, the Railroad Administration instructed on August 16, 1919, that all car forces be put on a basis of 54 hours per week.

STATUS OF U. S. R. A. OPEN-TOP CARS

Director General Hines has a statement in connection with the car supply situation, giving the status as of August 26, 1919, of the open-top cars contracted for by the Railroad Administration. Of the total of 50,000 open-top cars mentioned, 45,000 are coal cars.

OPEN-TOP CARS					
	55-ton Hopper	Com. Gond.	70-ton Hopper	70-ton low side	Total
Number ordered	22,000	20,000	3,000	5,000	50,000
Completed and in service August 26	12,935	8,051	762	2,397	24,145
Completed and in storage August 26 (the numbering and placing of these cars in service is now in progress)	8,186	8,498	794	17,478
To be built	879	3,451	2,238	1,809	8,377

The cars shown as being in storage, the statement says, are being numbered by the car works and placed in service at the rate of 250 to 275 per day. The railroad shops have been called upon to assist in numbering such cars and this will increase the daily number of such cars placed in service hereafter.

The cars shown as yet to be built are being built and placed in service at the rate of 75 per day, so that from 325 to 350 cars of this class are being put into service daily.

The composite gondolas are being delayed because two of the large plants have been on strike for the last month and consequently are turning out very few.

Two plants are building 70-ton low-side cars. One is now on strike.

INTERESTING APPLICATION OF HEAT.—The General Electric Review describes a method of heat shrinking for fitting parts of electrical machines on to their shafts which overcomes various difficulties experienced with press fittings. Water or steam heating is used for flywheels and couplings, while for armatures and field systems conveniently situated heating resistances answer the requirements. In the case of a large armature, the shaft was 35 in. in diameter. Cold pressing would have required a maximum pressure of 600 tons. By heating the armature to about 80 deg. C., however, the shaft could be pulled into the armature with a five-ton chain hoist.

MODERN METHODS OF PAINTING CARS

At the forty-eighth convention of the Master Car and Locomotive Painters' Association held at the Hotel La Salle, Chicago, September 9-11, the subject of painting was covered by a number of excellent papers and considerable discussion on the part of the delegates. We give below two of the papers presented at this convention, entitled "Preservation of Roofs on Passenger Cars" and "The Advantage of Using Pure Paints and More Time in Painting Steel Equipment." A report of other papers and the proceedings of the convention will be found in another section of this issue.

PRESERVATION OF PASSENGER CAR ROOFS

BY J. J. McNAMARA

Painter Foreman, Baltimore & Ohio, Western Lines

The steel roofs and decks of passenger equipment cars seem to present a vexing question, and correctly so when we consider the loss in metal from corrosion. It would seem that they will continue to be a source of worry until it is generally realized that the steel roof must be protected with paint coatings in a manner as good as the body of the car.

This operation, to my mind, should begin at the factory where the steel sheets should be sand-blasted lightly, heated and primed, while yet hot or before contraction has entirely set in. I am satisfied we can get better results in this way, than by priming the sheets when cold, on account of the absence of moisture on the surface and the primer setting up much more quickly, thereby shutting out moisture and gases, which are apt to cause corrosion.

I do not think it advisable to condemn the steel roof on passenger cars without giving it a fair trial, and this, to my mind, it has not gotten. It should be treated in the aforesaid manner and properly applied, with either strap or lap riveted seams, imbedded in red lead putty. At least three good coats of elastic paint should be applied at the time of application and the bow should be sanded. Thereafter once every twelve months it should be cleaned and touched up, applying according to condition, one or two good coats of elastic paint and sanding the bow. If this is done we will not hear so much about corrosion on passenger car steel roofs. If it becomes absolutely necessary to have this work done at terminal points it should be done by or under the supervision of a practical painter, and not left to the care of inexperienced terminal employees.

We cannot expect to get good results if we continue to paint steel roofs in the same slipshod manner as in the past. I would suggest taking up with our superior officers and our purchasing department and showing them the necessity for purchasing good material for this class of work and having it applied in a first class manner. If this is done we are going a long way towards protecting passenger car steel roofs from corrosion.

Untreated canvas of proper weight, preferably No. 6, makes a very good and serviceable roof for a wood car, if applied on a surface free from sharp edges. To this three heavy coats of lead and oil paint should be applied. The treated No. 8 canvas, however, cannot be depended upon for roof covering, and I cannot recommend it.

(Mr. McNamara submitted specimen plates to show the results secured by the method of painting which he advocated.)

DISCUSSION

H. H. Morgan (C. of Ga.), in a paper on this subject, stated that the practice on the Central of Georgia is to employ a handy man at each of the larger terminal points whose duty it is to carefully inspect the roofs and wherever one shows signs of wear to paint it immediately. This method keeps the roofs protected with live paint at all times and has

proven very successful. Out of sixty-seven steel cars in operation only one has come into the shop with the roof in bad condition, and that car was used in joint through service, running between terminals of other roads. Arrangements have been made to meet this condition by occasionally substituting other cars in the through trains for a sufficient length of time to make it possible to thoroughly inspect the regular equipment and do whatever work is necessary to put it in good condition.

There was considerable difference of opinion as to the advisability of sanding the bow at the end of the roof. B. E. Miller (D. L. & W.) stated that sand was detrimental to the paint. H. M. Butts (N. Y. C.) also considered sanding this surface bad practice, as it causes the paint to peel off in large patches. H. M. Butts and E. L. Younger (Mo. Pac.) advocated the use of sand on the ends of the car. J. W. Gibbons (A. T. & S. F.) expressed the opinion that the results depend largely on the atmospheric conditions, and if enough coats are used under the sand moisture will not work through and start corrosion. J. Sherrin (Penn. Lines) considered repainting every six months practical and economical.

THE ADVANTAGE OF USING PURE PAINTS AND MORE TIME IN PAINTING

BY W. BAILEY

Boston & Maine, Concord, N. H.

Paint should be applied to freight cars with a brush and with as much care as on any other surface. Any well known pigment mixed with linseed oil is the only commercial article worthy of the name of pure paint. Unsatisfactory painting can easily be traced to the use of poor paint and unskilled painting, such as spraying process.

Most of the commercial paint used today is a poor article compared with good linseed oil paint. Paint mixed with japan and a thinner when applied dries by evaporation and is consequently non-elastic and almost worthless for durability. On the other hand, a paint, the vehicle of which is linseed oil, dries by the absorption of oxygen and is much thicker when dry due to the amount of oxygen taken up in drying. It is elastic a long time and will resist atmospheric exposures longer than any other vehicle and consequently wear longer than any paint mixed with driers and thinners. Japan, or thinners, should not be used in any paint for outside surfaces and exposure. Nothing but boiled linseed oil should be used for a drier. I am a firm believer in the necessity of the sand-blast process for removing rust and scale, as the smoother the surface the longer the paint will wear.

One thing I am in doubt about, and that is, what is the best primer for steel, lampblack, graphite, white or red lead. I do not believe a paint containing a large percentage of oxide of iron should be used as a primer.

PAINTING SHOULD NOT BE RUSHED

A new car should have at least three coats of paint and ten days' time for painting, if one wants an economical job of painting. When cars are turned out with two coats of commercial paint in a few months 10 to 50 per cent of the surface is a mass of rust and scale. The car is seldom returned to the shops except for repairs, and then the same process is repeated. This is expensive. On the other hand, if a good, economical job is desired the car should be given a coat of lead primer and finished with two coats of paint.

If freight equipment could be shopped as regularly as passenger cars, and I think it just as essential, it would be a great saving to the railroads. As it is they are seldom sent to the shop until something needs repairs, and then the rush comes when in the hands of the painter. Passenger cars are shopped every year, principally for appearance sake, and if freight equipment could be shopped as regularly for protection it would be a great saving.

I think it is a right a painter owes to his own reputation as well as a duty he owes to his company to say all the good things he can of good paint and condemn poor paints. To get good paint you must mix it yourself. Twenty years ago mineral was used without grinding and gave better results than the present commercial prepared paints. Mineral, lampblack and graphite can all be used without grinding. Too much cannot be said in favor of linseed oil as a vehicle for paint. It is one of the few vegetable, fatty oils that dries by absorption of oxygen.

To conclude, it should be said that whenever railroads will take time enough to paint steel equipment with the right materials, and in a way that it should be done, then the work will stand, and in the long run economy will be the sure result. The steel coal cars one sees on every hand today are horrible examples of the poor judgment and haste that has been practiced in the painting of this equipment where it has been turned out of the car manufactories. There is no cure for it now but to sand-blast it off and paint it as it should be with right materials and practices. A stitch in time would have saved nine when the cars were built, but the nine stitches should be taken now to save the equipment before it rusts out completely, for there is nothing that deteriorates faster than steel unprotected with a suitable coating.

DISCUSSION

In discussing the materials used for pigments one member told of tests of paint made by mixing the mud from storage batteries with raw linseed oil. After two years' exposure it showed up well.

PORTABLE OXY-ACETYLENE WELDING APPARATUS.—In order to facilitate women's work in the repair shops of the Orleans Railway at Paris, a practical portable oxy-acetylene welding apparatus has been introduced. It consists of the usual cylinder of oxygen, filled under a pressure of 10 kilos, and the acetylene reservoir, these being mounted on a two-wheel wagon which can be easily moved from place to place even by a young girl. Flexible tubes several yards long connect the gases with the blowpipe, which is provided with the customary safety arrangement. It has been found that with this apparatus a woman worker is able to do a multitude of small soldering jobs with great rapidity and a minimum of fatigue.—*Scientific American*.



Photo Copyright by Underwood & Underwood, N. Y.

The Port of Georgetown in the Straits Settlements

SHOP PRACTICE

LARGE OXY-ACETYLENE WELD IN PENNSYLVANIA SHOPS

BY J. F. CHANDLER

Supervisor, in Charge of Maintenance of Way, Reclamation and Welding,
Pennsylvania Railroad

It is not often that the oxy-acetylene welder is called upon to exercise his skill and ingenuity to the extent of welding together two pieces of metal presenting a broken surface of 330 square inches, and there are those who loudly proclaim that a piece of work of such magnitude is beyond the realm of possibility. Hence, a description of the work accomplished so successfully at the Trenton, N. J., shops of



The Shear Blade After Welding; Line of Fracture Shown on Surface of Weld

the Pennsylvania Railroad, is of more than passing interest.

Through the lack of care of a yard employee, engaged in cutting up old metal, a piece of 1¼-in. by 4-in. steel was fed into a shearing machine in such a way that a bolt in the metal broke off the shear blade at the heel of the knife. This was caused by the twisting strain presented when the bolt was caught between the shear blades. The broken face was 33 in. in height, 13 in. in thickness at the bottom and 7 in. at the top. An examination of the broken parts showed the metal to be of the highest quality of cast iron, there being no flaws or sand holes, showing that the break was due entirely to misuse. The shear has capacity for cutting 3½-in. round bars, 3¾-in. flat bars, or 10-in. by 1½-in. flat bars, and is as large as cutting machines of this type are usually made.

Immediate repair became a very urgent problem, as it was impossible to order and secure a new machine under several weeks, if not months, and delay in replacement meant much delay in the making of billets and forgings for engine work, inasmuch as this shear is used almost daily in cutting metal for the large furnace from which billets are secured.

A great deal of work has been done with oxy-acetylene equipment at Trenton, but nothing to compare in size with the case here presented. The question of welding together broken pieces of so large a surface was submitted to an expert who expressed the opinion that the two parts could be welded perfectly.

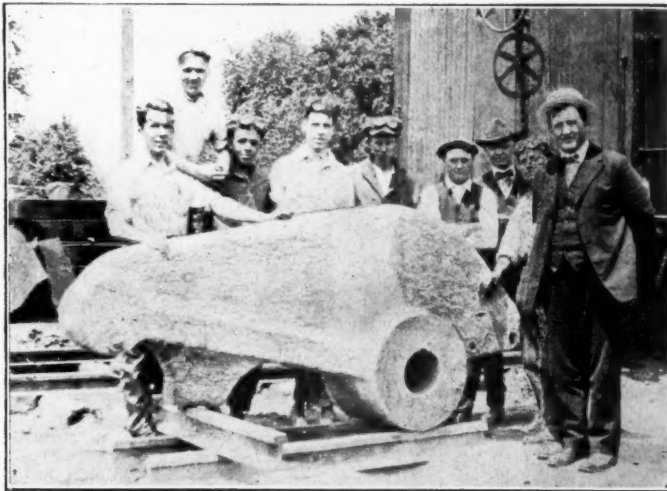
"Conscientious objectors" and scoffers were all there with their arguments against trying it, not realizing that even if

a failure resulted, we would be no worse off than with a broken shear, except for the expense entailed in the attempt. The matter of repairing was finally decided, and permission was given to do the work.

The broken parts were taken to the machine shop and the metal was planed away at an angle of 45 deg. from both sides of each piece, on one side to 65 per cent of the thickness and to 35 per cent on the other, so that when the two parts were brought together, lying on their sides, an edge only about ¼ in. thick remained. This was left as an aid in setting the parts for preheating and welding, and for the purpose of preserving the exact length of the shear blade. This work required two days, after which time the parts were ready for preheating.

The broken parts were laid flat, set accurately and firmly secured. A fire brick furnace was built around them and a charcoal fire started. After eight hours of preheating, the temperature was at the proper point to commence welding.

The deeper cutting, the 65 per cent side, was welded first. Oxweld cast iron alloy rods of ¼-in. and ⅜-in. diameter were fused in from the bottom up and outward from the middle of the cutting. Ferro flux was used in this work, being constantly added to insure fusion of the metal.



The Repaired Blade and the Men Who Did the Work

After it had been filled and slightly re-enforced to prevent fracture in handling the casting was turned over and the other side welded up in the same manner. It will be noted from the illustrations that the cavity to be filled was of an astonishing size.

Six welders were assigned to the work, and were worked in relays of two each, using four Oxweld outfits with No. 15 welding heads. The extra number of men was necessary because of the intense heat generated, not only by the torches but by such a large mass of iron on a large charcoal fire. In fact, the heat was so great that those using the torches protected their faces with asbestos masks, and it was frequently necessary to dip their gloved hands into water to

cool them. Compressed air also was used to blow the hot air away from the men at work.

The men engaged in the work were enthusiastic as to its success, and knowing they were engaged in a most extraordinary undertaking, were exceedingly careful to see that nothing untoward should happen to endanger the success of their efforts, nor that any lack of attention should militate against the desired end.

There were used in the repair of this shear:

Oxweld cast iron alloy rod.....	445 lb.
Oxweld ferro flux	12 lb.
Acetylene	6,116 cu. ft.
Oxygen	7,640 cu. ft.
Labor at 68 cents, in both pre-heating and welding.....	203 hours
Charcoal	100 bushels
Coke	20 bushels

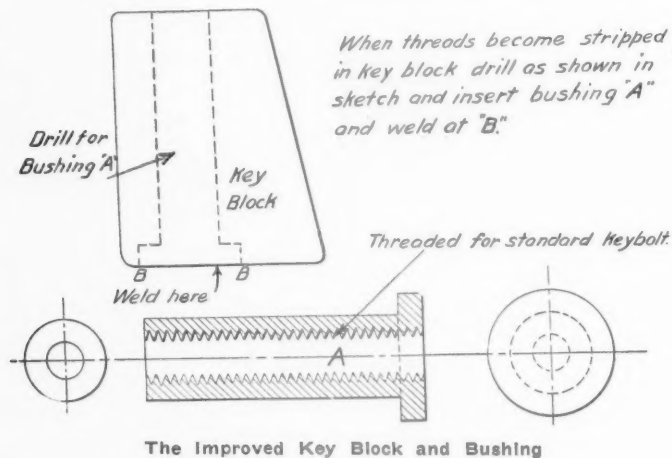
The total cost of making the repair was about \$400. The cost of a new shear blade is variously estimated at from \$1,500 to \$1,700, so that the saving by welding approximated \$1,200, to say nothing of the loss by being deprived of the use of this machine.

The shear has been fully tested and is doing business as usual. It appears to be as good as new.

IMPROVED KEY BLOCK FOR MAIN RODS

BY J. H. HAHN

An improved key block for the front ends of main rods is shown in the sketch. Considerable trouble is often experienced with the ordinary design of key block, due to the stripping of the threads, which usually necessitates a new key block. With this improved type of key block, however, when the thread strips, it is only necessary to remove the bushing *A* and replace it with a new one. When the threads in a key block of the ordinary type become stripped, it can easily be converted to the improved design by drilling it out



and welding in the bushing *A*, as illustrated. These bushings can be made cheaply on a turret lathe and carried in stock ready for use, and are easily and quickly inserted, thus facilitating the despatch of an engine from the roundhouse and also effecting a considerable saving in the cost of both material and labor.

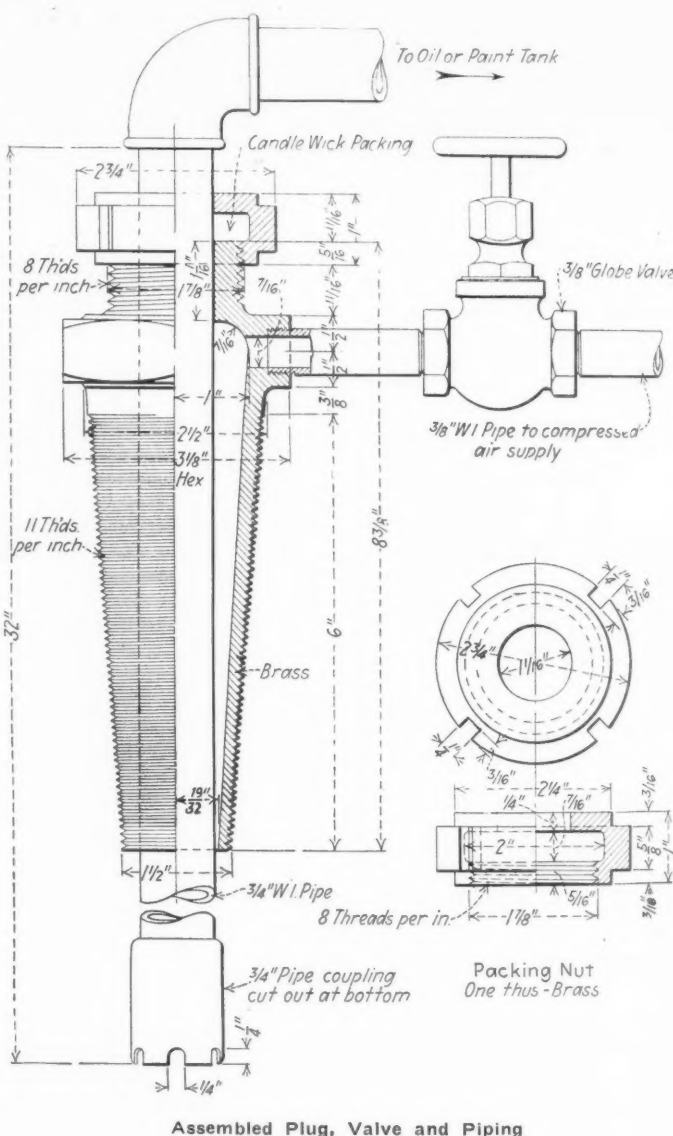
RAILWAY ROLLING STOCK IN FRANCE.—During 1913 France produced 700 locomotives, 2,000 passenger cars and 18,000 freight cars. Before the war it was necessary to import rolling stock, but today it is expected that after the equipment plants in the North are reconstructed, France will be able to export both cars and locomotives after the present requirements of 1,000 locomotives, 2,600 passenger cars and 24,000 freight cars are provided. In 1913, France imported railway rolling stock to the value of 23,000,000 francs and exported 7,000,000 francs.—*Le Génie Civil*.

REMOVING LIQUIDS FROM BARRELS OR OTHER CONTAINERS

BY NORMAN McLEOD

A means of removing oil or other liquids from barrels or any closed container is shown in the drawing. This device consists of a $\frac{3}{4}$ -in. pipe inserted through a tapered metal plug, which is threaded to screw into the bung-hole of the container.

The plug is a hollow shell for the greater portion of its length and a hole is drilled and tapped through the side to receive a $\frac{3}{8}$ -in. air connection which is fitted with a globe valve to control the air pressure. A number of apertures are cut in the lower end of the outlet pipe so that the pipe





D. L. & W. Locomotive Shops at Scranton, Pa.

GENERAL FOREMEN'S CONVENTION

Papers on Accident Prevention in Shops and Engine-houses, and the Welding of Locomotive Cylinders

THE fifteenth convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, on Sept. 2-5 with a large attendance representing all sections of the country. During the four days' sessions papers dealing with some of the important technical problems in connection with the repairing of locomotives and cars were presented and in addition labor conditions were discussed informally. The convention was opened with an invocation by Bishop Nicholson. The report of the secretary-treasurer was then read which showed the total membership to be 221, and the balance in the treasury \$752.

ADDRESS OF R. H. AISHTON

R. H. Aishton, regional director of the Northwestern Region, spoke on the present railroad situation. Mr. Aishton emphasized the importance of securing increased production in all industries and quoted a letter from Walker D. Hines in which the director-general stated that in his opinion less progress had been made in securing increased efficiency in maintenance of equipment than in any other department. The higher railroad officers, Mr. Aishton said, come in contact with the actual operation of the roads only through statistics and because of that fact it is important that the foreman should be competent and progressive in determining the policies in his own department. He endorsed the proposal to put an end to wage controversies and restore more nearly normal conditions, characterizing this policy as necessary from a patriotic standpoint to keep America from falling behind in the contest for world trade.

ADDRESS OF PRESIDENT L. A. NORTH

Following Mr. Aishton's speech L. A. North, superintendent of shops of the Illinois Central, and president of the association, delivered an address. Mr. North spoke in part as follows: The General Foremen's Association was formed primarily for educational purposes only. Our intent and purpose is to furnish a channel for the full, free flow of ideas

pertaining to the best mechanical practices and from this stream of experience to add to our store of knowledge. The greater the demand upon the transportation system of the United States, the greater is the responsibility of those charged with its maintenance. This association must be made one of the potent forces in the progress of transportation. During the war period many appeals were made to us to further the common cause of our country. In my opinion, the present crisis of the nation is just as acute. Let us, therefore, rise to the issue and meet it in a loyal and determined spirit and go home from this convention with a high resolve to do our utmost toward strengthening our nation's facilities.

At the conclusion of President North's address W. W. Scott made a short response in which he dwelt on the difficulties which supervising officers experience under present conditions. He stated that in his opinion the efficiency of shops and roundhouses had decreased 50 per cent in the past five years.

ACCIDENT PREVENTION IN SHOPS AND ENGINEHOUSES

The Wednesday session of the convention was devoted to a discussion of methods of preventing injuries. R. C. Richards, claim agent of the Chicago & North Western, made an address in which he reviewed the results of the safety work conducted during the past nine years on the Chicago & North Western. Several papers outlining methods adopted in safety work were read, some of which are abstracted below:

SAFETY FIRST

BY B. F. HARRIS

General Foreman, Southern Pacific, Oakland, Cal.

To generate and maintain a living interest in the movement to protect life and preserve the body from injury, we must face a difficulty that may be relieved by one or more of the following measures: (1) Imposing penalties for gross negligence. (2) Awarding premiums for creditable records. (3) Publishing the names of persons injured. (4) Publish-

ing an honor roll of those who have been uninjured during the month.

Negligence may be generally divided into two classes: Neglect of the injured and neglect contributed by one or more who created the condition causing the accident, or who had guilty knowledge that such condition existed. As any penalty, however mild, may cause resentment and produce an interest that might detract from, rather than contribute to, the effectiveness of Safety First, the most convincing evidence should be required before inflicting a penalty on any party. It should then be tempered with due moderation, should it be imposed on the injured person. Mathematically stated: The punishment suffered from the accident should be subtracted from the penalty that would be due to an uninjured,

SAFETY FIRST IN SHOP AND ENGINEHOUSE SERVICE

BY W. T. GALE

General Foreman, Chicago & North Western, Chicago, Ill.

New lines of thought and action, with Safety First as the slogan, should be ever welcome to all, more especially to those who may have suffered directly or indirectly from the carelessness or thoughtlessness of others. Safety First, when carried to its proper issue, bespeaks life and happiness in its best phases. On the other hand, the cold indifference and selfishness of some, make for suffering for others. The criminally careless, and those who neglect to have a proper care for the safety of others, merit just scorn and severe censure from those to whom they are responsible. Selfishness and carelessness make for discomfort and misery to others.



L. A. North (I. C.)
President



W. T. Gale (C. & N. W.)
First Vice-President



J. B. Wright (H. V.)
Second Vice-President

or second party, who had caused it. This is a period of broken precedents, it follows that a proposal to award premiums to encourage creditable caution, productive of records free from accounts of accidents, will not be met with surprise, but may be thought possible.

Many simple rewards may be given, among them the following:

- (1) Cancellation of discredit for former accidents.
- (2) Creation of new credits.
- (3) Issuance of an annual pass for the best record in each department on every division, (a full year's record included).
- (4) A vacation on pay.

The suggestions of four classes of awards should be sufficient to start this phase of Safety First growing.

When a person's name is published as the principal in an accident, there is a condition of mind produced among large bodies of men to discourage all forms of negligence and foolhardiness. Every person of good health and average understanding has enough self pride to avoid public exposure of their identity with accidents. The interest excited by exposure is not pleasant but results are usually forthcoming.

Appreciation is one of the natural cravings of every human mind. The most effective application of the principle is to publicly acknowledge the caution of employees, at each division point, shop, or yard, by posting an honor roll, each month, of all persons who have passed through the preceding month without being a party to an injury. Although it should not be expected that there will be a marked rivalry to keep one's own name on an honor roll we may well know that the acknowledgment of continued caution on the part of workmen will prevent resentment from those who are sensitive when their efforts are not recognized. A trial of these four measures as outlined will soon demonstrate their value as a means of reducing injuries to a minimum and the advantages to be gained are worth all that it is likely to cost.

The results of the safety movement on the Chicago & North Western have been highly gratifying. The shop committees hold semi-monthly meetings, after making inspection of the various departments. At these meetings reports are made of the unsafe condition of tools, machinery, etc., and recommendations covering the same.

These local committees have accomplished most excellent results in shops and roundhouse service; all machines with gears or other working parts exposed and considered a menace to the safety of the operator have received attention and the danger, if any, averted. Line shaft couplings have sheet iron covers, the dangerous setscrew has been abolished, men have been protected from falling belts, all of which make for safety. Glass windows have been placed in all communicating doors between the various shops, in order that employees who are carrying dangerous implements in their hand, or on their shoulders can see and thus avoid injuries. Emery grinders have sheet iron guards around the wheels, and an adjustable frame with glass in it is attached to wheel guard which allows operators to grind tools without getting the flying particles of emery in their eyes, a round smooth iron cup is placed over the end of the emery wheel mandrel nut, preventing employees' working jackets from being caught upon the end of the revolving shaft. Danger sign posts are placed in proper positions in shops when repairs are being made overhead, employees' working tools, such as hammers, chisels, driving mandrels, etc., are examined by the foreman and the safety committee for cracks or breaks, and sharp splintered edges, and when found are replaced by new or repaired ones. Broken and rotted floors are kept in repair, automatic bells and gongs are placed on all transfer tables and moving cranes, air warning whistles for overhead cranes are a feature, the man who oils overhead machinery is supplied with a strong metal warning whistle, in order that the operators of machines below will not start up machinery.

Floor motors in shops have 1 in. pipe guard rails placed around them, open fuses have been replaced by N. E. C. cartridge fuses, all open switches have been enclosed in steel cabinets with spring hinged doors, the replacing of all fuses is done by an electrician only, motors and generator frames have been permanently grounded to avoid accidents by shorts, open wiring has been replaced by conduit and lead cables, all line shaft motors have been equipped with safety stop control buttons, all drop light cords over machines are being removed, and replaced by individual cords, vapor proof lamps have been installed in oil houses and acetylene store houses. Electricians remove main line fuses when going above to do repair work on cranes, especially from automatic floor operated cranes. Crane men are not allowed to

thrown in a bath of wood alcohol, and allowed to remain for a stated length of time, after which they are removed and thoroughly dried. This in a great measure overcame any objections from this source. Then, again, complaint was made that the goggles were too heavy and clouded up during the extreme warm weather. This has been overcome by securing a lighter goggle, and a better ventilated one, so that at the present time we do not experience a great deal of trouble in requesting the employee to wear the goggle and carry out the instructions that have been issued in regard to eye protection. As the eye injuries were numerous throughout the entire plant, this was one matter that required a strenuous campaign to decrease personal injury.

Papers dealing with the safety movement were also pre-



G. H. Logan (C. & N. W.)
Third Vice-President



H. E. Warner (N. Y. C.)
Fourth Vice-President



W. F. Hall
Secretary-Treasurer

keep anything on the crane floor with the exception of grease and waste, safety ropes are attached to cranes for descending in emergency. All employees are required to use and are furnished glass goggles for dangerous work. A large wooden platform fitting over the top of the boiler for grinding in stand pipes is a safe contrivance for men doing this work.

Hoisting chains and wire cable are regularly examined for flaws, lights have been put in dark places and roofs ventilated when necessary. Strong iron cans are used to hold scrap paper and waste during the day, the same being taken out of the shop at night. There are local fire alarm boxes in every shop, water hose pipes and hydrants in and out of the shops, an efficient fire fighting company, a doctor upon the shop grounds with able assistants to care for emergency cases. In engine house service, firing-up wood is not put into the cab until it is time to fire up the engine on account of men working in the cab and danger from nails in wood. Men have been instructed in the use of the blow-down pipe to see that it is laid flat upon the floor, and that connections are properly made so that there will be no danger of the pipe blowing off under pressure, etc., all of which shows that safety first is not a question of dollars and cents, but a question of saving human life, the most valuable thing in the world.

ELIMINATING EYE INJURIES

BY L. A. NORTH

Superintendent of Shops, Illinois Central, Burnside, Ill.

One of our greatest obstacles in the Safety First movement has been in getting the employees to wear the goggles which the company have furnished to properly protect their eyes. Comment was received at the start on account of fear of eye infection. This was overcome by constructing a sterilizer so that when the goggles were returned to the tool-room, being given out to the employee on a check, they were

sent by C. Coleman (C. & N. W.), J. B. Wright (H. V.), J. W. Womble, W. L. Shaffer and J. Powell.

WELDING OF LOCOMOTIVE CYLINDERS

BY L. A. NORTH

The welding of locomotive cylinders and other parts has been made possible and very successful by the introduction of oxy-acetylene and electric welding. It has been possible to weld locomotive cylinders which formerly would have been scrapped or repaired with either a brass patch or a dovetailed insert of some other metal, the weld in the majority of cases making a substantial and satisfactory job provided the expansion and contraction had been properly taken care of.

Experience has taught us that in order to properly weld a locomotive cylinder, or a casting of any make or design, it is necessary to thoroughly pre-heat to insure a uniform temperature in order to properly take care of the contraction and expansion and to avoid cracking after the weld has been made and the metal has been allowed to cool off. The success of any weld of this kind depends largely on the care used in the pre-heating and the judgment of the operator making the weld. We cannot be too particular in the selection of the operator for this class of work.

Some difficult welds have come to my observation, one in particular, where the entire upper portion of the cylinder at the port-area had been totally destroyed. This was repaired by having a grey iron patch cast in the foundry, fastened to the cylinder by means of clamps and welded in place. The cylinder was pre-heated to a uniform temperature to take care of the expansion and contraction. After the weld had been made and the cylinder had cooled down, a reinforcement was added to this weld by drilling through between the stud holes and securing the additional support by tap bolts which were tapped and screwed into the main barrel.

It is possible to weld broken bridges in slide valve cylinders successfully. Recently this was done and effected a saving of two cylinders in place of the one, which was cracked, as the cylinder which was repaired was an obsolete pattern and had we not been able to make this weld, the application of an entire pair of cylinders to this engine would have been necessary. As this engine was one that in a few years will be placed in the scrap pile, I am satisfied that the weld will outwear the present cylinders.

Not having experience with electric welding on cast iron, I am not prepared to enter into a discussion of this method to any great extent, but I have examined a number of castings which have been repaired with the electric welding process and careful examination failed to disclose any flaw or fault in the weld.

AUTOGENOUS WELDING OF CYLINDERS AND OTHER PARTS

BY J. T. LEACH

General Foreman, Pennsylvania Lines, Wellsville, O.

The welding of cylinders and other castings by the carbo-hydrogen, oxy-acetylene or electric process has made great progress in the last few years. Hardly any discovery or invention has meant so much to the railroads and casting manufacturers as the various methods of welding broken or defective castings.

There was a time when it was necessary to inspect all cylinders on locomotives before they were taken into the shop for classified repairs, in order to know that no new cylinders were required, as the stock of cylinders carried by the stores department was limited, and if a broken cylinder could not be patched and the storekeeper had no casting, the locomotive had to be held awaiting repairs until such time as the material could be procured. This was an expensive arrangement at the best, especially in the last few years when power was so badly needed. With the different methods of welding cast iron, a cylinder may be cracked or broken quite badly, yet it can be repaired successfully. The question arises as to the cost compared with a new cylinder, except in case of a new design where patterns have not been provided by the railroad or a foreign type of locomotive for which it would require several months to get a cylinder.

In making electric welds, in case the cylinder is only cracked, it is first necessary to pull the cylinder back in place, as nearly as possible, by the use of a rod and clamp. If this will not do the rod should be heated and the cylinder pulled up in that manner. The entire surface should be cut cut V-shaped at an angle of from 45 to 55 degrees and then drilled and tapped on both sides of the crack for $\frac{5}{8}$ in. to $\frac{3}{4}$ in. studs. These studs should be staggered, that is, one row to be drilled down on the bend and the other staggered in the flat portion of the cylinder. The studs should be screwed in the cylinder $\frac{5}{8}$ in. or $\frac{3}{4}$ in. and then cut off about $\frac{1}{4}$ in. from the casting. All dirt should be cleaned from the portion to be welded before starting the welding. This welding should be done at a slow rate of speed in order to keep the cast iron cylinder from becoming heated. In welding the cylinder the ordinary grade of Swiss welding rods of $\frac{3}{8}$ in. or $\frac{5}{32}$ in. diameter should be used. It is not necessary to remove the bushing or do any pre-heating to get a satisfactory weld, although if this is done a much better weld would be the result.

The cost of an acetylene weld is from \$50 to \$175 for an ordinary weld. This is an average figure, for the jobs vary so much in size and time that it is hard to arrive at a true average, however, the saving in any case amounts to several hundred dollars.

The method of welding by the oxy-acetylene process is as follows: The cracked portion should be cut out V-shaped at an angle of about 60 degrees. If the broken or cracked por-

tion is bulged out, a rod and clamp should be used to pull it up as nearly to the original position as possible. The dirt should be cleaned from the area to be welded. Then a furnace of brick should be built around the cylinder and by means of a charcoal fire or blow torch the cylinder should be heated to a cherry red. In some places an acetylene torch is used for pre-heating the cylinder, but that is expensive.

After the cylinder has been pre-heated to the required heat welding should be begun, always maintaining the charcoal fire so the cylinder will have a uniform heat. In welding special silicon cast iron sticks are used and if this is not available a good grade of air pump rings will answer. The welding of the cylinder should be continuous, and if it is a large break, one operator should relieve the other. This keeps the casting at a uniform heat. If the casting is allowed to cool, the weld will crack. The charcoal or blow torch fire should be kept up for several hours after the weld has been completed and then allowed to die out.

Acetylene welds cost considerably more than welds made by the electric process, but this is often due in part to the lack of experience of the operator and also to the method followed. The experience I have had with carbo-hydrogen has been limited to cutting mostly, but it is possible to get the same result from it in welding cast iron.

Other papers on the subject of autogenous welding were also prepared by W. Gale (C. & N. W.), B. F. Harris (Sou. Pac.), J. H. Frizell (A. T. & S. F.), J. W. Womble and J. Powell.

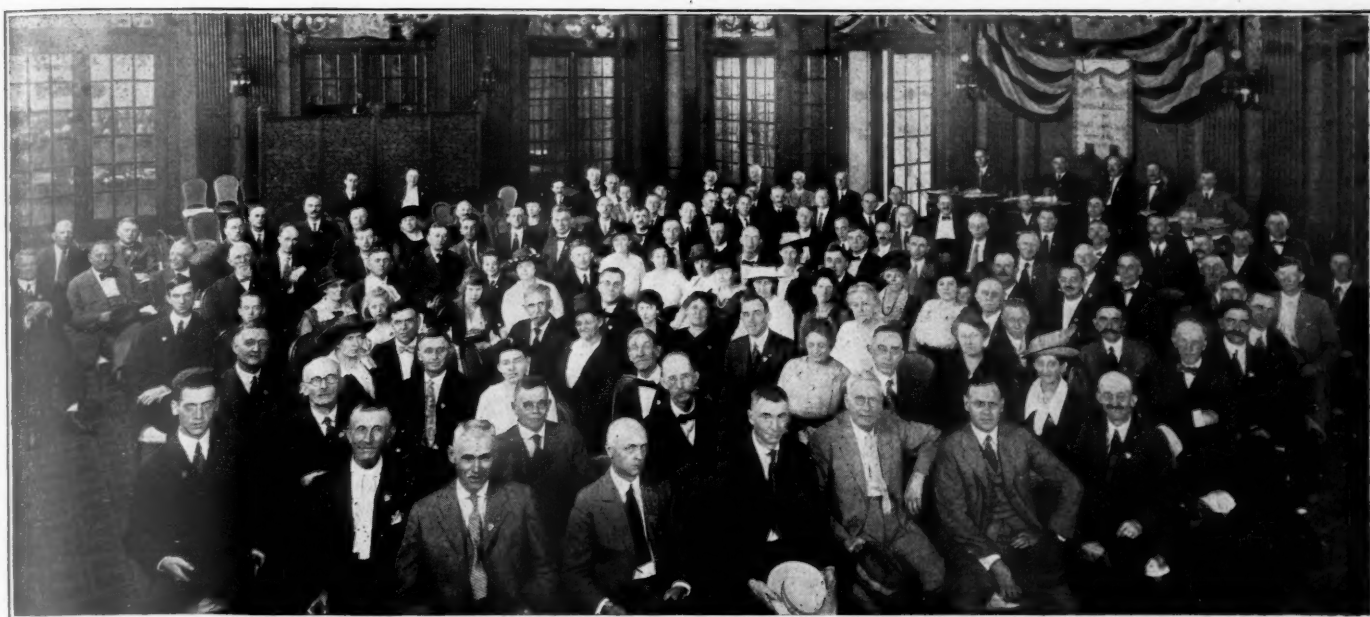
DISCUSSION

C. D. Walker (Great Northern) advocated banding and bushing cracked cylinders on the ground that the cost of doing the work by that method was lower than when autogenous welding processes were used. Several other members concurred in this opinion, although the majority preferred to weld longitudinal cracks even though the defect could be corrected by the use of clamps or bands. J. M. Horne (M. & St. L.) stated that good results had been secured by using brass wire for cylinder welding, but this method was not generally favored due to the high cost of the wire. M. H. Westbrook (Gd. Trunk) described methods used for burning out bushings by the use of a carbon electrode. He also stated that by using sulphur on the weld the added metal was made soft so that it could be machined readily. Mr. Westbrook gave average figures for the cost of welding as follows: Oxy-acetylene process, \$3.00 per hour; electric welding process, .90 per hour.

OTHER BUSINESS

Several papers on the design and maintenance of draft gear were read and discussed, an account of which will be found in Car Department of this issue.

During the convention the question of admitting supervising officers of the car department to the association was considered and the by-laws were amended to make general foremen of the car department eligible for membership. On Thursday V. R. Hawthorne, secretary of the Mechanical Section of the American Railroad Association, outlined the organization under which it was proposed to have the General Foremen's Association affiliate with the American Railroad Association as a division of the Mechanical Section. A committee was appointed to consider and report upon this matter. The following officers were elected: President, W. T. Gale, machine foreman, Chicago & North Western; first vice-president, A. B. Wright, general foreman, Hocking Valley; second vice-president, G. H. Logan, general foreman, Chicago & North Western; third vice-president, H. E. Warner, superintendent shop, New York Central; fourth vice-president, T. J. Mullin, general foreman shop, Lake Erie & Western; secretary-treasurer, William Hall, directing foreman, Chicago & North Western; chairman, executive committee, C. A. Barnes, general foreman, Belt Railway of Chicago.



CONVENTION OF MASTER PAINTERS

Association Amalgamates With A. R. A.; Papers
on Standardization and Linseed Oil Substitutes

IMPORTANT changes in the organization of the association and action designed to bring about more satisfactory methods of purchasing paint and varnish were the outstanding features of the forty-eighth convention of the Master Car and Locomotive Painters' Association which was held at the Hotel La Salle, Chicago, September 9-11. For some time past the officers had had under consideration the proposal to amalgamate with the American Railroad Association as a division of the Mechanical Section. This matter was brought before the convention and after considerable discussion the members present by unanimous vote decided to merge with the parent organization, thus becoming a division of Section III, Mechanical.

The first convention session was opened with prayer, following which an address of welcome was delivered by a representative of the Chicago Association of Commerce. J. S. Gearhart, president of the association, then delivered an address in which he reviewed the organization's activities during the past three years and outlined the proposed amalgamation with the American Railroad Association. The convention then proceeded to take up the discussion of the technical papers prepared by the members, which are abstracted below.

WHAT STANDARDIZATION OF PAINTING RAILWAY EQUIPMENT IS NECESSARY?

Two papers were presented on this subject, one by W. O. Quest, master painter of the Pittsburgh & Lake Erie, McKees Rocks, Pa., and the other by W. A. Buchanan, foreman painter, Delaware, Lackawanna & Western, East Buffalo, N. Y.

PAPER BY W. O. QUEST

At the present hour, the most necessary and essential paint shop standardization would be some practical method of satisfying labor on the matter of wages in the painting of equipment. Will it be possible to standardize the labor operations of the railway car paint shops now under govern-

ment control? As something of an optimist, strong in the faith that the American workman will soon realize that to bring order out of a threatened social upheaval, he must turn back to the old-time ideas of soberness and thrift, I do believe that it can be, will be, and must be done. But how such desired standardization is to be brought about, is open for the suggestive powers of just such an assembly as this. I believe that it can be happily brought about, if an amicable live and let live arrangement is made in the spirit of fair dealing between the railway organizations as employers and the employees.

PIECE WORK SYSTEM ADVOCATED

The labor of painting cars and locomotives, etc., could be standardized by the adoption of a universal piece price system, the wage paying system that we firmly believe in as the most equitable to employ any kind of labor, the most equitable for all interests, notwithstanding the fact that modern labor federations in recent years have been instrumental in entirely abolishing this method of employing labor in the American railway shop systems. In my opinion, a fair scheduled piece price system is the only method whereby labor can give a fair equivalent for wages paid. Such a proposed piece price schedule, to be standardized, should be job named and not numbered. The unit or fixed prices should be open to shop inspection at all times and never officially juggled in the event of the more skilled labor earning more pay when called upon to help out in a shop rushed for output. If a piece price labor standardization can be put into action, the prices should be so scheduled that the earnings of a first class skilled worker in a railway car paint shop would equal the earning rate of the outside general trade skilled worker. The original schedule of prices should be carefully figured out and classified, each job continuously named regardless of name repetition in the several classifications. The original job prices as scheduled should never be price changed, as we have found it to be no easy matter for the men to follow up such changes. It was sure to create dissatisfaction.

When found necessary to advance or lower the wage scale, an up and down percentage method should be used.

STANDARDIZATION OF MATERIALS

Next to the labor problem, the most important issue would be that of specifying the standardization of paint supplies, as there cannot be any fixed material standardization without manufacturing, purchasing, chemical and application specifications. The paint and varnish maker will be called upon to furnish certain standards of car shop specialty material on fixed paint making formulas, that must be lived up to. Something represented as just as good or better at a lower price, unless first tested by some prescribed authority, cannot be consistently introduced without upsetting the primary law that demands standardized materials. Possibly in many instances this material is theoretically or authoritatively formulated from raw paint stock listed on the open market, which is often unsuitable or perhaps ruinously mixed by people who are trying to meet competition in the paint business, but do not know the special requirements of the railway paint shop.

There are no suggestions that will safely promote a material standardization in the railway paint shop, if the purchasing departments continue to buy paint stock on price regardless of known quality or the paint-making reputation of the selling concerns. Companies have in the past and still will in the future break into the railway paint field, without knowing that such paint is a specialty and is especially applied.

If any such suggested railway paint standardization ever becomes a law, the activities of the railway chemical laboratories will be quite strenuous and especially active when they come to the matter of settling the many disputes sure to arise.

METHOD OF APPLICATION IMPORTANT

It is in the application of the paint stock that the master car painter must receive his full recognition. He will have to be put on the standardizing committees with full power to act, as he and he only knows what is necessary to make a good job. If what is termed necessary standardization of certain or all classes of job paint work is adopted, he will as usual be held responsible for the labor and material costs.

I will here offer a list of work items that in my opinion could be readily standardized, if it is found necessary to try the standardization scheme out. If adaptable, locomotive painting should be standardized. The quality of the protective paint and varnish should be the best weather, smoke, acid or grease resisting paint stock that can be found on the market at any price. Every inch of the painted metal surface should be sandblast cleaned. All castings to be painted, should be chipped off smooth and freed of live rust, etc., with the sandblast, as it is a waste of time and money to paint over crusted unremoved grease, mill flash, or live rust of any kind. If the work is standardized, the paint specifications should call for hard, tough, elastic paint stock, as it is a great mistake to apply soft oil paint where it is to come in direct contact with solvent cutting greases and acids, which when deposited on the locomotive's painted surface, can only be removed by heavy erosive cleaning.

The painting of passenger, mail, baggage, and similar cars could be classified as to labor and material. Owing to the sameness of the work the jobs could be readily standardized. When material classifications are being standardized, the many examples of the best paint and varnishing finishing systems which have been successfully used for many years in the railway paint shop should not be forgotten in the standardization arrangements, and the interests of worthy manufacturers should be protected owing to the fact that their specialty products have helped to make car painting history.

UNIFORM STENCILING OF FREIGHT CARS

Based on the past work of this association's efforts to establish standards in freight car painting, especially to standardize the stencil markings, which undoubtedly has been and still is one of the most pronounced wasters of time, labor and material that the railway officials are confronted with, we heartily endorse the idea of standardizing every detail that covers the painting and stencil marking of the railway freight car. In the standardization scheme, the stencil lettering and numbering should be made in the same style and sizes and sent out from a designated manufacturing base in pounce pattern form. If made by skilled stencil makers from established drawings, the stenciled railway freight car would present a neat lettered appearance.

The paint repair costs of the future would be light, owing to the undisputed fact that such a railway freight car stenciling standardization scheme would save thousands of dollars in stencil-making costs for every railway company that will endorse and adopt such standardization.

PAPER BY W. A. BUCHANAN

When locomotives are undergoing heavy repairs, a very careful check should be made of the condition of the paint on cab and tender. If it is found to be blistered or badly fractured and the shopping period will permit, the old surface of the paint should be removed by sandblasting if the steel construction, or any other suitable method. The sandblast is preferable for it not only removes the paint but gives a clean bright surface to again build up a good paint foundation which is very essential on locomotive tanks, where the surrounding elements are so destructive. This is also true of the cab and domes, also the steam chest and drivers.

A well equipped lye vat is almost indispensable for the cleaning of the small parts before painting. Wash tanks, for sash and doors should be installed, equipped with hot and cold water. A good system of stationary scaffolding is found to be a great convenience and time saver, as labor is a factor that cannot be lightly dealt with under the present order of things.

METHOD OF PAINTING FOR METAL SURFACES ON LOCOMOTIVES

After the foundation work has been properly prepared a system of surfacing as follows will be found very elastic and durable. The priming coat for steel surfaces should consist of a good elastic primer. After applying it should be allowed to dry at least 48 hours, after which, a second coat consisting of one half primer and one half surfacer, can be applied and allowed to dry for 24 hours. Next all uneven surfaces should be puttied with hard drying lead putty, then the whole surface knifed with No. 3 surfacer or surfacing compound. When sufficiently dry one coat of roughstuff should be applied. If desired, it can be colored and serve as a guide coat, which will save time. This surface can be rubbed the following day.

After being sandpapered the first coat of color should be applied. It has been found a good practice to continue the elastic coatings. If black enamel is to be used the first coat can be reduced one-third with pure turpentine. This method can also be followed in the second coat of enamel. After the lettering and striping is applied two coats of good elastic varnish should be applied. The first coat can be a good quality of rubbing varnish. It should be allowed 12 hours to dry, then a second coat of good elastic finishing varnish should be applied.

Cut-in jobs are treated practically the same excepting sandblasting, and under coatings. With fair usage, surfaces thus built up should last at least five years before again requiring removal of the paint. The engine frames should be thoroughly scraped and cleaned and then painted with one coat of a good quality of frame black. Trucks and tank frames should be

treated practically the same, excepting that the outside of the frames should be varnished. The interior of tank frames should be painted with two coats of a good oil black, when new or when decks are removed when undergoing general repairs. Jackets and all upper work usually can be protected with one coat of a good quality of black enamel.

The interior of the cab, including all pipe work, after being thoroughly cleaned and touched up, should receive one coat of enamel of any shade desired. Cab roofs, if of steel construction, should be thoroughly painted with some good quality of steel car paint. The coal spaces and decks of tenders must be carefully cared for as the elements they carry are very destructive to steel plates if not well protected with paint.

PAINTING AND STENCILING FREIGHT CARS

The painting of freight cars has become more essential at present than at any other time since the building of this class of equipment. This is due to the fact that steel is fast replacing wood in their construction. Greater care must be exercised in their upkeep for the life of steel is rather brief if not carefully watched and kept painted.

When cars are new or rebuilt it is very essential, especially on steel cars, to thoroughly clean and paint all laps. Red lead has been found to be the best material for this purpose.

lower markings should include the capacity of the car, the cubical measurements, the date built, the class, date and where last painted, and also the weight of the car and the safety appliance markings. Any special information such as when boxes were last packed should also be placed in this group. All the information a car inspector requires to handle this phase of his duties with despatch are thus placed in one group. To the right of the door can be placed the information showing the class of commodities the car was designed to carry. The lower markings on this side of the door should show the length, height, and width of the car.

On the end of the car should be shown the initials of the road and the number of the car, placed to the right of the brake wheel. The lower marking should consist of the following information: the kind of triple valves the car is equipped with, the kind and size of coupler shank, the kind of draft rigging and brake beams (No. 1 or No. 2). The doors of the car should be stenciled on the inside only, and should show the initial of the road and the number of the car.

Air brake equipment should at all times be kept painted and stenciled showing when last cleaned and where done. When selecting cars for repainting this information should be taken and booked, for if found to be in date, it must be replaced on the cylinder of equipment. The omission of



J. Gearhart (Pa.)
President



J. W. Gibbons (A. T. & S. F.)
First Vice-President



A. P. Dane (B. & M.)
Secretary-Treasurer

Freight car bodies of wood construction should be coated with a good metallic paint underneath all corner irons, or plates before they are applied. This also applies to running boards before they are applied.

After cars are ready for painting the priming coat should be applied as soon as possible. A mixture of one part pigment (if metallic semi-paste, ground in oil) to three parts vehicle has proved very satisfactory for this purpose. Additional coats can be followed up each day under favorable climatic conditions.

The stenciling is next in order and should consist of a good plain readable letter or numeral, either of Roman or Egyptian style. Insofar as possible, a uniform practice of grouping the information should prevail on all roads. Master painters will readily see the advantage to be derived in the saving of time and expense, if such an arrangement existed. No class of car men would appreciate it more than the car inspector and yard men who are obliged to get their information very often from the sides of cars and very many times under the most adverse conditions. We would, therefore, recommend that a standard distribution of stenciling for box cars be as follows:

The initials or name of the road together with the number of the car should be placed to the left of the door. The

properly maintaining this information is a reportable defect. The stenciling of trucks showing the name of the road and the number of the car the truck belongs to is essential. When cleaning up wrecks or derailment of cars, unless this information can be gathered the sorting out of the right trucks is almost impossible, for in many cases the car body has been completely destroyed.

PREPARING STEEL CARS FOR PAINTING

The painting of steel car equipment should be very carefully watched. The first coatings on new steel cars are very often done with too little regard as to the preparation of the plates before the paint is applied. All dust or flash scale should be removed if possible for unless this is done paint will not adhere to the steel very long and work that should wear at least three years is in bad condition after one year.

If possible, sandblasting is the best method of preparing steel plates for initial coatings. However, should this means of cleaning be unattainable, then we must resort to the hook scrapers after which dusting with a steel wire brush is resorted to. This serves the purpose very well for removing rust formations, but will not remove the flash scale. Coatings for steel hopper and steel gondola cars should consist of a good carbon pigment ground in oil and mixed to meet pre-

vailing condition. Under no conditions should one coat of paint be expected to protect this class of equipment.

No system of painting could be considered complete without suitable quarters for handling the work with the least possible delay to shopping periods. We would, therefore, recommend that suitable tracks be assigned, either inside or outside of shops, equipped with a good dry air line of 80 or 90 lb. pressure, for the purpose of air dusting cars and spraying the under portions of bodies and trucks. Ample space between tracks is also very desirable.

The stencilling of this class of equipment should be maintained practically the same as on box cars; i. e., kept to the left of the car, or centrally located. The weighing and stencilling of equipment is a very important feature and should be constantly watched, for in selecting cars for repainting, the old light weight is a part of the record. The painter should place this in a book with the other items, necessary for record, concerning the car. This enables him to properly check any material difference in the new as compared with the old weight.

DISCUSSION

H. M. Butts (N. Y. C.) proposed that the association issue a pamphlet of approved practices for painting railway equipment. There was some difference of opinion regarding the relative merit of carbon and lead paint. J. W. Gibbons (A. T. & S. F.) stated that for steel underframes he considered red lead and carbon black better than two coats of carbon black. W. A. Buchanan told of steel freight cars painted with carbon paint in good condition after 17 years.

SELECTION AND PURCHASE OF PAINT

BY S. E. BREESE

Foreman Painter, New York Central, Collinswood, O.

Previous to the advent of the United States Railroad Administration the master painter of the railroad was the sole authority as regards paint and varnish both as to materials used and methods of application, and was responsible to his immediate superior for the results obtained. By virtue of this authority and through his experience and ability he secured certain desired results acceptable to the road which employed him. He accepted full responsibility as to results obtained and viewed with pride the results of his work. This pride was justified by the condition and appearance of the equipment coming under his jurisdiction. By an interchange of ideas, the foreman painter was constantly striving for progressive methods, economy, labor saving systems and durability in his work. He chose his tools, his men and his materials and through the proper co-ordination of all three secured results. The questions which I believe are of paramount importance are, whether the above conditions still exist and whether we are still responsible for results and have authority as to what tools to use, methods to employ, or materials to apply.

At the present time the purchasing department chooses and gives us our tools and material and asks for results. Are we allowing our responsibility to be shifted, our authority to be questioned and our methods attacked and submitting to it all without a protest? We were employed for a specific purpose, namely, to maintain equipment in good shape, secure economy as to methods, costs and time factors and yet are unable to choose our methods or materials. If this has come about what is the cause and what is the remedy?

MASTER PAINTERS SHOULD CHOOSE MATERIAL

A successful organization is one in which the authority vested in each department is absolute and co-ordinated and results are obtained only by a complete assumption of responsibility by the head of each department. In this way a chain of organization is forged, which is strong, well co-ordinated and successful only when each department has this full

authority. Are we allowing our department to become the weak link of the railroad shop organization by a question of divided authority or a shifting of responsibility? It is essential that we become cognizant of the real danger of shifting our responsibility, accepting divided authority and lowering our standard methods and materials.

I believe the greatest trouble has been with material rather than with methods of application. This is primarily in the hands of the purchasing department and there has been some little friction over the materials bought for use. Due to the very nature of each department's position, there must necessarily be some friction, as the office of the purchasing department is the securing of materials designed to accomplish certain specified purposes at as cheap a price as possible with due regard for the quality and durability of the articles purchased. The purchasing department must, because of its lack of knowledge concerning the materials used, be absolutely dependent as to the question of durability and quality on information secured from the mechanical department, which in turn secures this information by co-operation with the master painter. This information is obtained by a consideration of a number of essential points including practical equipment tests and weather tests, chemical tests, information secured through the sales representatives of paint and varnish concerns, regarding the tests made by them of the material in question, and the knowledge and experience of the master painter due to his specialization on these problems.

CHEMICAL TESTING OF PAINT

The chemical testing of varnish or paint materials has been up to date of little value as a reliable source of information, especially as regards durability. In fact, up to date, except in the case of raw materials, a chemical test is of no use to the painting department. The experienced painter by a few practical tests, such as elasticity, working and drying, can usually determine and foretell through his experience the possible durability of the article in question. General Atterbury has stated "In my experience the only materials which we were unable to purchase by specification were paint, varnish and rubber. In the purchase of the above materials, I was absolutely dependent for information on the man in closest touch with the materials, who by his specialization and experience usually could be called upon to adopt the material best suited for the purpose." This still holds true.

The purchasing department backed in many cases by the arguments advanced by sales representatives have succeeded in selling the mechanical department materials against the judgment of the master painter, who accepts these materials rather than get into a controversy. This has brought about changes in materials and standards all tending towards less efficiency and lessened durability, which means higher cost of maintenance in the end. This false economy is now being felt by the equipment upon which it was used. Goods of every description and standards are pouring into the shop; changes are being made from month to month on nearly all materials. Our only duty seems to be to apply them.

INFERIOR MATERIAL NOW BEING USED

As the price of raw materials advances, the price of paint and varnish declines, a queer economic anomaly which is only explained by a reduction in quality. The purchasing department notwithstanding the above, continues to buy at still lower prices, without consideration of durability or the standards of the road. This is a direct infringement on the authority of the man who, by his experience and specialization, has been placed in the position of the final judge of paint efficiency and durability. It is part of our job to make decisions regarding durability and efficiency. We have all seen certain materials installed as a standard for painting, whose false economy, is now becoming apparent, and which was apparent to us in the beginning. What is the remedy of

this situation? A sales representative told me that any justifiable complaint made to the person in direct charge was always seriously considered by the purchasing department in placing orders, but as the complaints are not made, the purchasing department establishes a precedent for the purchase of still cheaper material. Have we been afraid to complain, have we refused to use materials for the purpose intended? The refusal of these materials would also establish a precedent for the discontinuance of the purchase of such materials. Let us not close our eyes to apparent faults without attempting by honest argument and frank discussion to remedy the situation. Let us carry this to a successful conclusion and put our association back of the fight for efficiency, economy, and durability of all forms of painting equipment, and retain full and undivided authority as to methods employed and standards adopted.

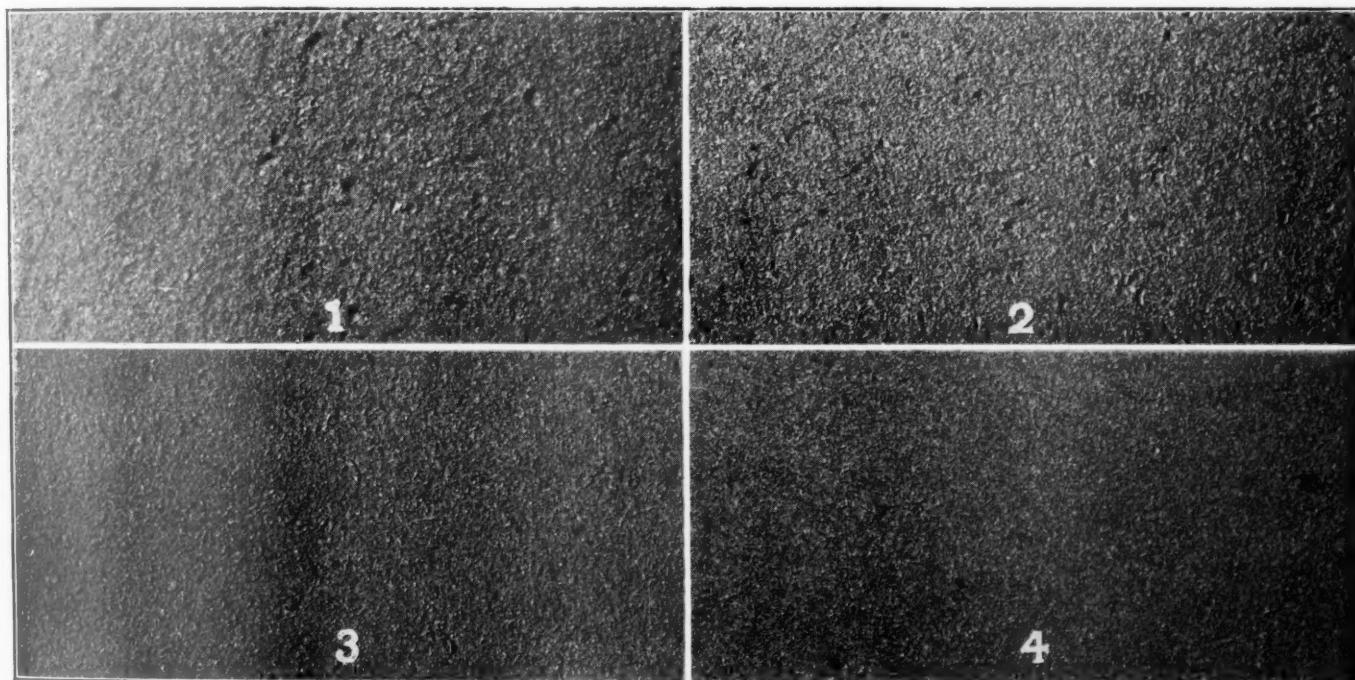
DISCUSSION

The members as a whole agreed that much poor material was submitted and accepted where paint was bought on specifications only. Several stated that material received under present specifications was not satisfactory. Although

naturally raised a doubt in the minds of some as to the desirability of using a sandblast in preparing a metal surface for paint. Even in conventions of this association, the durability of paint applied over a sandblasted surface compared to a non-sandblasted surface has been questioned. This state of affairs has held particularly true with regard to steel roofs.

The above facts, no doubt, prompted the committee in their selection of the above question for discussion. In my opinion, the essentials necessary to secure good results from sandblasting metal preparatory to paint, are the quality and size of the sand pebbles and the velocity and volume of the projectiles thrown against the surface. As to quality, any sand that is hard and firm will answer. The less dust or dirt it contains the better from every point of view. As to the size of the sand pebbles, I submit four photographs to show the results secured with various sizes.

A photograph of a steel plate sandblasted with sand run through a 4 by 4 mesh sieve is shown in Fig. 1. Note the torn condition of the metal; the pin points are numerous. When paint is applied over a surface like this and subjected to the attrition of wind, rain, sleet and cinders, incident to



No. 1 Blasted with Sand Sifted Through 4 by 4 Mesh, No. 2 Through 6 by 6 Mesh, No. 3 Through 10 by 10 Mesh, No. 4 Through 16 by 16 Mesh Screen

experience indicated that the paint would not give good service, it met the tests prescribed and for that reason there was no alternative but to accept it. J. W. Gibbons (A. T. & S. F.) emphasized the fact that the efficiency of painting should be judged not by the number of cars painted for a given expenditure, nor the speed with which the work was completed, but rather by the length of the intervals between painting.

BEST QUALITY AND SIZE OF SAND FOR SAND BLASTING

BY J. W. GIBBONS

Foreman Locomotive Painter, Atchison, Topeka & Santa Fe, Topeka, Kan.

Experience having taught us that the sandblast is the most economical and thorough method of removing the flash scale corrosion and old paint from a metal surface, economy of operation has been the only thing considered, durability or cost of finishing the surface has been lost sight of, with the result that a surface which was practically impossible to preserve with paint, has frequently been obtained. This

service conditions, the sharp projections puncture the paint film, allowing moisture to seep under the paint, carrying with it all the destructive agencies of the sulphurous products from coal burning locomotives or furnaces. Corrosion sets in, deteriorates and frequently destroys the metal before we realize that anything is wrong.

Fig. 2 is a photograph of a plate sandblasted with sand run through a 6 by 6 mesh sieve and is practically as poor a surface to paint over as that shown in Fig. 1. A photograph of a plate sandblasted with sand run through a 10 by 10 mesh sieve is shown in Fig. 3, while Fig. 4 shows a plate sandblasted with sand run through a 16 by 16 mesh sieve. Figs. 3 and 4 present an ideal surface or paint with just sufficient roughness to give tooth to the paint and hold it firm and solid.

These plates were all cut from the same piece of sheet steel and sandblasted with the same quality of sand. The velocity and volume of projectiles was also the same on all plates, the only difference was in the size of the sand pebble

and, in my opinion, proves that the size of pebble enters largely in the results obtained by sandblasting.

The second part of my claim, that the velocity and volume of the projectiles are also essential, may not be as susceptible of proof by photographs, but if you take a sheet of steel and throw a heavy volume of sand upon it with a high velocity, you will find that it will not only tear the metal, but will warp the sheet.

When we consider that sand run through a 16 by 16 mesh sieve will clean practically as much surface in a day as sand run through a 6 by 6 mesh and that the only extra cost is in the time required to sift the sand and in the per cent of sand available, and that this extra cost is more than made up in the time required to paint and surface up the metal, there can be no excuse for using a coarse grade of sand. As to velocity and volume of projectiles, in my judgment, the air pressure should not be less than 70 or more than 90 lb. per sq. in., and the size of nozzle should not be over $\frac{3}{8}$ in. or less than $\frac{1}{4}$ in. in diameter. To secure durability of paint surface and the proper protection of metal, the character of surface obtained by sandblast is as essential as the quality of paint applied.

DISCUSSION

G. M. Oates (Pressed Steel Car Company), presented a paper on this subject. his company formerly used No. 8 crushed quartz from Warsaw, Wis. The material was satisfactory, but on account of the high freight charges, its use was discontinued and No. 3 $\frac{1}{2}$ silica from Youngstown, O., had been substituted with good results. Silica sand, however, will only remove rust and scale while the quartz will cut old paint as well.

SUBSTITUTE FOR LINSEED OIL

BY. A. H. F. PHILLIPS

Master Painter, New York, Ontario & Western, Middletown, N. Y.

There have been great demands for linseed oil, and some specialists predict that the call for seed to fill these large contracts will become so urgent that higher prices will eventually be realized. If such is the case, it will mean almost a prohibitive price for use in a railway paint shop. We can at least safely say that the demand is very great and is persistent.

There has been a general shortage in flax seed, which still continues. The Canadian and American supply continues light, and Argentine conditions are not changed particularly. Prices and freight are high, and cargo space at a premium. American buyers have been credited with considerable stocks in warehouses, but receipts and available supplies are somewhat limited.

Under the present conditions of the market, the demand for linseed oil is in excess of the supply, and there is no question that there is a genuine shortage of oil. Perhaps, at some future time when the market becomes more normal the supply may possibly equal the demand and prices may not be so high as to almost prohibit the use of linseed oil as a paint making oil.

PROPERTIES OF VEGETABLE PAINT OILS

For some time past the railway paint shops have been receiving many paint oils as substitutes for linseed oil. I believe there is none, as yet, equal to linseed oil as paint making oil. A paint oil as a substitute for linseed oil for use in the railway paint shop can be made, and is being made and sold by many companies, on a linseed oil base, and of the same gravity. This dries with a good gloss, as it contains enough of volatile oils as conveyors to assist materially in the application of the paint when evaporated in drying, leaves a thoroughly elastic and highly protective oil film in combination with the pigment. This paint oil can be used in thinning out paints of any character, oxide, car-

bon, lead or zinc, where oil is desired as a thinner, without danger of any chemical action. Such oil would probably be called a combination oil. I am not prepared to assert what oils make up such a paint oil.

Vegetable oils are used by many in making up their paint oils, namely, cotton seed oil, soya bean oil, hempseed oil, corn oil, peanut oil, cocoanut oil, etc. These vegetable oils being largely food oils and used extensively in paint making oils as substitutes for linseed have found an increasing market. Mineral oils are also used in the paint oils to some extent, but I do not think it advisable to be too free in the use of paraffin oils. Owing to the great demands for linseed oil and the scarcity of the supply, also prices soaring up almost to a prohibitive figure for general use in the paint shop, substitute oils have found a place in making paint oils for use in the railway paint shop.

OILS OTHER THAN LINSEED USED IN PAINT

There are quite a number of these, drying, semi-drying and non-drying and not a few have their special uses in paint. The most important of the drying variety is China wood oil or tung oil. Poppy seed oil is prominent for grinding the finer grades of zinc white and artists' colors, and must be classed among the drying paint oils for the reason that when pressed from ripe seed it dries very nearly as rapidly as raw linseed oil. The reason for the use of poppyseed in colors or paints is due to the non-darkening of this oil and its free spreading. Bombay nut oil was at one time largely offered at a price somewhat lower than poppyseed oil. It was very clear, almost water white, and its drying property fully equal to that of bleached linseed oil. However, this oil has not been heard from in the market for some time.

Sunflower seed oil is also classed among the drying oils, but it has not found its way into general commerce and therefore nothing more is known about it than has been ascertained in an experimental way. Hempseed oil also belongs to the class of vegetable drying oils, but this seed being raised principally in Russia and a few other localities in Europe, is used mostly there as a paint oil; and if any is brought to this country is comes as an admixture with linseed oil.

Another vegetable drying oil that has been largely imported for some time into this country and Europe, under the name of candle nut oil by soapmakers and is known to science as Kukui oil, is now being tested by progressive varnish and paint manufacturers. It bids fair to be a strong competitor of linseed oil when its characteristics become better known to the trade and it is prepared in a more scientific manner than it is now. Other drying vegetable oils, as nigerseed oil, tobacco seed oil, Scotch firseed oil, etc., that are not readily obtainable in commerce, are not at all interesting to the paint maker and color grinder.

FISH OIL HAS LIMITED USE

Another oil, which is of animal origin, is the fish oil known as Menhaden oil. This is barred out, however, from use in many paint materials, especially in interior paints, because of its offensive odor, and is made use of only in special outside paints as in roof paints and stack paints, and by some manufacturers in other specialties.

Among the substitutes for linseed oil that interest paint manufacturers most should be classed soya bean oil, corn oil and cottonseed oil. Soya bean oil requires fully ten days to dry to a film and then the film will not be as firm as raw linseed oil which requires six days to dry to a film. Since linseed oil is extraordinarily high priced there is quite a demand for bean oil, and it is quite a task for paint makers to discover methods to make their products dry in the ordinary way. The usual practice was to use equal portions of soya

bean oil and boiled linseed oil, or when this would not work out well in some paints the bean oil portion was increased and also the driers.

Corn or maize oil has been in use in paints for many years, but is made use of only when linseed oil is high in price. This oil has very little, if any, drying properties, and will harden to a brittle, rather mealy film in from twenty to thirty days. Cottonseed oil has no drying properties, but is a good lubricant, and previous to its rise in price when it came to be used as a cooking and table oil, it was used to adulterate linseed oil. Rosin oils are not only used in printing-ink making, but were largely employed in making paint for rough surfaces, though since their price has advanced to twice, even three times their former cost, they have been replaced by mineral paint oils to a great extent in paint. Rosin oils are practically non-drying, and while they harden in time will soften again under the influence of sun heat and make the paint film part, or alligator. Pine oil and tar oil are products from the distillation of wood spirit and of rosin, and are used in the manufacture of marine paints, especially paints for ships bottoms. These oils are semi-drying and water resisting to a degree.

MINERAL OIL WILL NOT RESIST MOISTURE

Mineral paint or paint and putty oil, so called among the trade, is refined petroleum or neutral oil, so named because debloomed. These oils cannot be used without being mixed in certain percentages with boiled linseed oil, as they lack binder and are apt to wash off the surface in case of driving rains. Even when used in large portions in a liquid paint for rough surfaces such paints have been known to wash off when they were supposed to have dried hard a month or two before. Petroleum products of this class will sweat, thus causing softening of the film and consequent damage to it by water.

Cheap paints for use on rough lumber or other rough surfaces can be made by grinding the base in linseed oil (usually boiled), thinning with a mixture of about 35 gallons of gloss oil (rosin and benzine mixture), 10 gallons of raw linseed oil and 5 gallons of liquid drier. Or if it must be still cheaper a thinner can be made of 30 gallons of gloss oil, 15 gallons of debloomed neutral paraffin oil and 5 gallons of lead and manganese drier. In any case, however, the pigment to be used as the base for the paint should be ground in linseed oil.

So far linseed oil has not found an equal in paint making, although the subject has been one of deep study, and while other fixed oils have been discovered that for certain purposes have been expected to take its place, it has yet to be demonstrated that such is really the case in long practice. China wood or tung oil, while superior to linseed oil in certain directions, especially in its resisting power to water, has not shown itself adapted to replace linseed oil in making oil paints as we know and desire them.

When linseed oil is placed on a strip of glass that has been painted jet black and shows a bloom, or iridescence, it is adulterated with mineral oil or rosin oil. Admixture of linseed oil and corn oil or linseed oil and cottonseed oil can be detected by placing some of the oil between the palms of the hands, rubbing briskly and noting the odor thus emitted. The presence of soya bean oil, however, cannot well be ascertained by simple tests, and a chemical analysis is necessary, though even that is sometimes misleading.

THE FIELD FOR SUBSTITUTE OILS

BY P. J. HOFFMAN

Master Painter, Hocking Valley, Columbus, O.

The shortage of linseed oil makes it imperative that we find an acceptable substitute oil. In some instances, it is absolutely necessary that we use linseed oil, but on the other

hand, whenever we can use a substitute with the desired results we are saving that much linseed oil to overcome the present shortage. Tung oil is used very extensively in the place of linseed oil in the manufacture of certain grades of varnish, and a mixture of tung oil and linseed oil has a greater resistance to moisture than the pure raw oil, consequently in cases where the paint is subject to the rains, snows, sleet, etc., such as platforms, trucks, or castings, it is an improvement over linseed oil. Then again, certain oils will stand the heat better than linseed oil, and therefore are better fitted for the heated parts of locomotives, etc. There is on the market a substitute oil for the grinding of pigments that has given universal satisfaction. I have for a number of years used a substitute oil in all our freight car equipment that has fully stood the test, especially in point of service rendered.

Different bodies and surfaces require different substitute oils according to the nature of the object painted and the kind of usage the paint has to withstand. How far we can go with a special paint for a special purpose is in my opinion the solution to the question. If we can by diligent research conserve the linseed oil by the use of a substitute oil, we have overcome some of the shortage of the linseed oil. The difficulty in using substitute oils is that irresponsible companies will make and market an oil substitute that has no virtue and we will try one and then another without getting results until at last we will become so disgusted that we will revert back to the old reliable linseed oil.

Unless we can have a certain paint for a certain purpose, I am skeptical as to the advisability of using substitute oils. Then the question arises is it practical from a money standpoint. We will have great quantities of different kinds of paints that are used only on certain jobs and the stock will be so augmented that the stock room will have to be enlarged and in all probability it will necessitate the adding of more help to take care of the stock. Then again the loss of interest on the money that is tied up in the excess stock paint will have to be considered, loss from evaporation and deterioration from paint exposed at long periods make it even more expensive. These with the many more added expenses that are sure to be incurred with larger stocks will, to my mind, overcome all that can possibly be saved by attempting to use substitute oil.

DISCUSSION

A paper on this subject was also presented by F. B. Davenport (Penn. Lines). J. W. Gibbons (A. T. & S. F.) stated that mineral oil should not be used with putty as it evaporates and leaves a powder that soon flakes off affording no protection for the glass. Good putty effects a saving of glass and labor many times greater than the increased cost of the material. Mr. Gibbons stated that linseed oil is not necessary in paint that is not exposed to the weather.

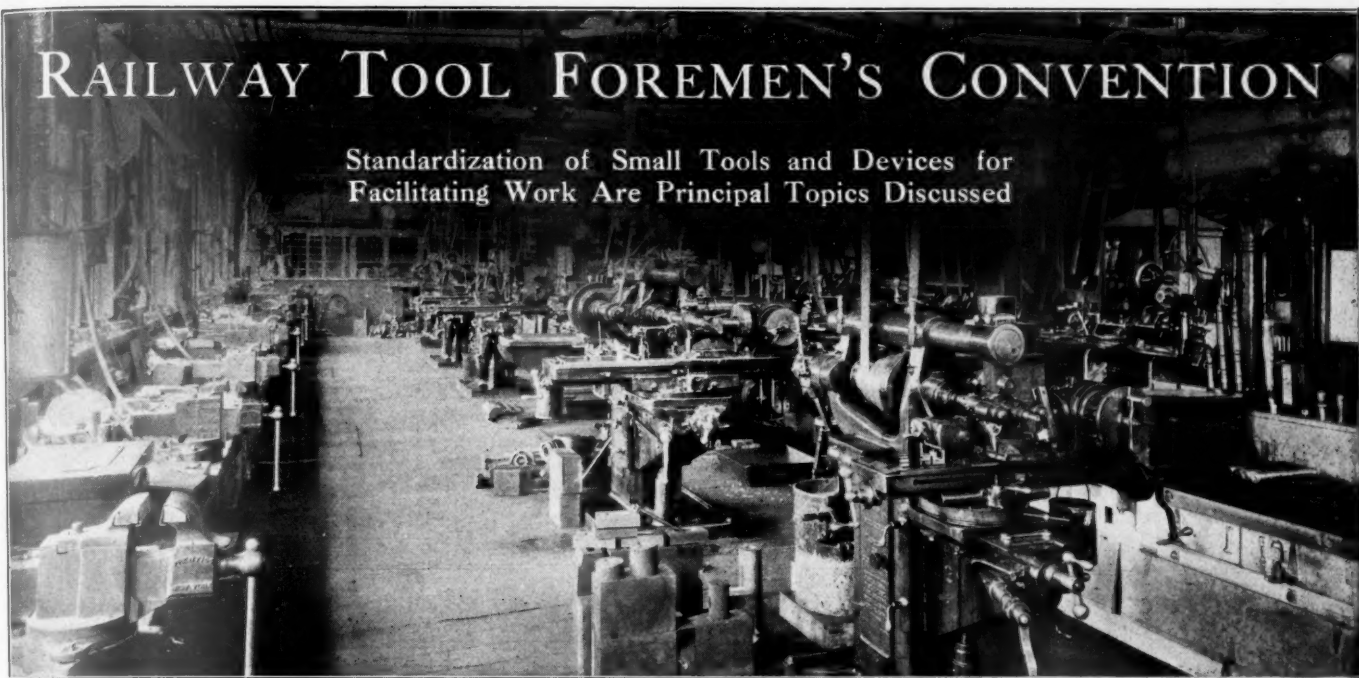
OTHER BUSINESS

F. B. Davenport (Penn. Lines) told of the results secured with a special heat resisting paint developed for use on car roofs. C. E. Copp (B. & M.) presented a paper on the record of the Master Painters' Association. Papers on Painting of Steel Equipment and Roofs of Passenger Cars will be found in the Car Department of this issue.

The secretary-treasurer reported a total membership of 328 and a satisfactory balance in the treasury. The following officers were elected: Chairman, J. W. Gibbons (A. T. & S. F.); first vice-chairman, E. L. Younger (Mo. Pac.); second vice-chairman, J. G. Keil (N. Y. C.); secretary-treasurer, A. P. Dane (B. & M.). Boston was chosen as the place of the next meeting, which will mark the fiftieth anniversary of the founding of the Master Car and Locomotive Painters' Association.

RAILWAY TOOL FOREMEN'S CONVENTION

Standardization of Small Tools and Devices for Facilitating Work Are Principal Topics Discussed



THE American Railway Tool Foremen's Association held its ninth convention at the Hotel Sherman, Chicago, August 27-29. Following the opening prayer, the convention was welcomed by G. C. Niemeyer, representing the states attorney. The president then introduced W. E. Dunham, assistant to the general superintendent motive power and car department, Chicago & North Western, who spoke of the relation of the tool foremen's work to the efficiency of the shop.

ADDRESS OF W. E. DUNHAM

Mr. Dunham said in part: The tool foremen and the tool foremen's organization are the heart and life of a railroad shop. What the tool room is and what the tool room foreman accomplishes affects every department. If the tool room is not furnishing efficient tools, the morale and spirit of the entire shop is gone. The tool foreman ought to give

PRESIDENT'S ADDRESS

The president, C. A. Shaffer, general supervisor, shop machinery and tools, Illinois Central, reviewed the activities of the association since the last convention in 1916. He urged the members to put forth a special effort to enlarge the organization and to continue the work which would bring about higher efficiency in railroad tool service.

STANDARD DEVICES FOR LOCOMOTIVE

BY E. J. McKERNAN

Supervisor of Tools, A. T. & S. F., Topeka, Kan.

There has been a great demand for practical devices for use in making repairs to locomotives and cars, and through the efforts and cooperation of the American Railway Tool Foremen's Association many good devices and ideas have



C. A. Shaffer (I. C.)
President



J. C. Bevelle (E. P. & S. W.)
First Vice-President



R. D. Fletcher (Belt Ry. of Chic.)
Secretary-Treasurer

attention to every tool in the plant, and those from which the proper output is not being secured should be overhauled so that the utmost production can be obtained. We must see that the equipment the railroads have in their shops is in efficient condition. In this matter the Tool Foremen's Association has a very vital part to play in the reconstruction period through which the railroads are going.

been disclosed. There are shown below a few devices which have been found to be very practical for the various classes of work here described.

Several practical devices used in making repairs to air brake equipment are shown in Fig. 1. By the use of these tools we have been able to reclaim many parts that otherwise would be considered scrap, and from a financial stand-

point we have made a very creditable showing. These tools are made up in the Topeka shop tool room and standard sets are furnished to all points on the line.

Boiler check reseating tools and reamers which have proven very satisfactory for the repairing of boiler checks in the back shop and especially in the roundhouse in making running repairs are shown in Figs. 3 to 5. These devices are inexpensive and very simple to make and handy to operate, and they are instrumental in eliminating many engine failures and leaky boiler checks. In order to eliminate the possibility of our mechanics using improper tools on the leaky boiler checks, we found it advantageous to stencil each reseating tool with the pattern number of the casting for which it is intended.

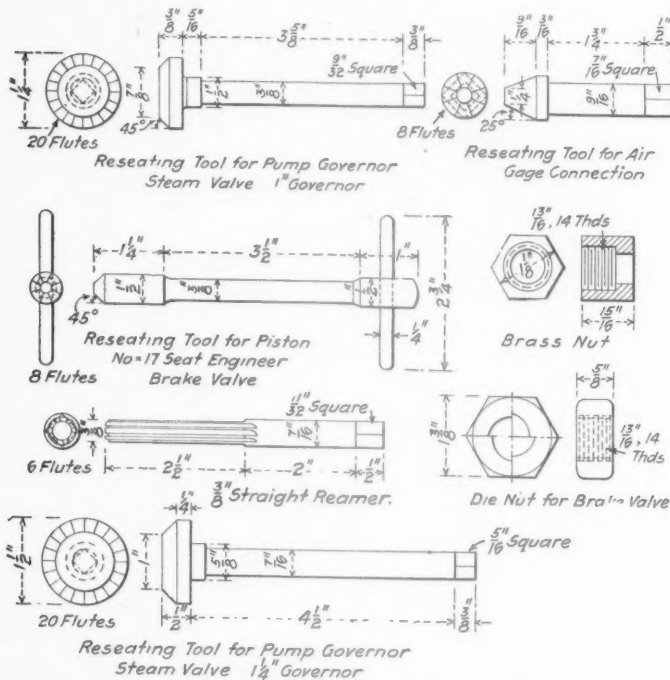


Fig. 1—Tools for Repairing Air Brake Parts

Reseating tools for blow-off cocks are shown in Figs. 5 and 6. By the use of these tools the possibility of leaks can be eliminated and the tool is so constructed that any one can operate it without difficulty. This tool is also stenciled for the particular boiler blow-off cock on which it is to be used.

Fig. 2 shows reseating tools for the outside and inside throttle valves for non-lifting injector, and Fig. 8 shows reseating tools for Chicago lifting injector throttle ram seats.

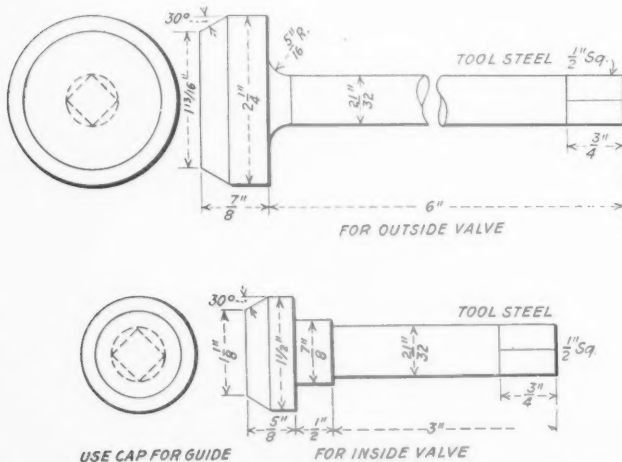


Fig. 2—Non-Lifting Injector Throttle Valve Reseating Tool

A lubricator throttle valve reseating tool is shown in Fig. 9. This tool has proven to be very handy and efficient, and all roundhouses are furnished with tools of this kind.

A reseating tool for superheater damper cylinders is shown in Fig. 10. We find that by the use of this tool we can eliminate the possibility of leaks to the cylinder, and it is indispensable.

STANDARDIZATION OF TOOLS.

In this day and age the individual idea should be subordinated to such an extent that we should adopt practices that would give us better efficiency, reduce the cost of output, and on the other hand simplify the tool situation whenever possible. It has been plainly shown that the adoption of standard practices by the American Railway Master

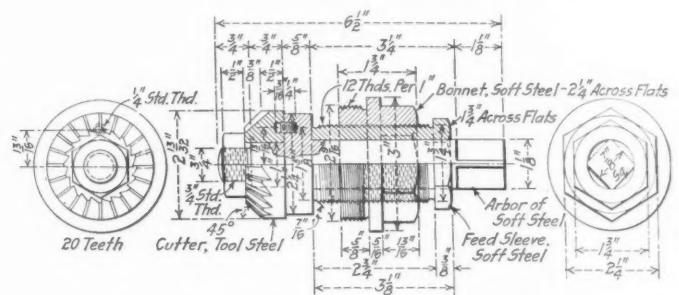


Fig. 3—Reseating Tool for Ohio Boiler Checks

Mechanics' Association was a good move. When a standard practice was adopted by that body it was carried.

In the past eight years the members of the American Railway Tool Foremen's Association have attended meetings and returned to their respective homes and made reports to their local officials on these subjects, but unfortunately they did not get the co-operation that they should have received. As each of the tool foremen who attend these conventions receive instructions from their superiors to attend, they should be invested with such confidence that when they make a report to their superiors that a certain tool has met with approval of the association and been adopted as

Part No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Teeth Keyway
LS 924	2"	2 1/8"	1 1/2"	1 3/8"	2 1/8"	1 1/2"	3"	3"	1 1/4"	2 1/8"	3 1/8"	3 1/8"	3 1/8"	2 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	30
LS 2083	2 1/4"	3 1/8"	2 1/8"	3 1/8"	1 1/2"	3 1/8"	3 1/8"	3 1/8"	2 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	3 1/8"	40

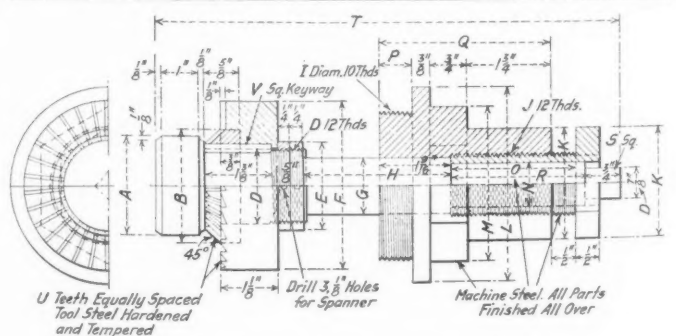


Fig. 4—Boiler Check Reseating Tool

standard, the higher officers should put forth an effort to put this into practice. If we could standardize the tool equipment on all American railroads and use the same methods and practices there is no question that it would eliminate a great deal of the making of unnecessary tools. While I appreciate the fact that the tool room foremen and the superintendents of motor power have a certain amount of self-pride in the making of all tools for their respective railroads, nevertheless, the progressive man of today must be able to give and take whenever necessary in order that he may develop a method that will insure better production.

In the automobile industry, where all parts must be interchangeable, the first practice is to get the tools made to the standard before starting production and these tools are maintained to an extremely high standard of accuracy. If this is found to be good practice from a manufacturing standpoint, why is it not a good practice in the railroad shop? There is only one solution, and that is co-operation, and the insistence on the adoption of practical methods and standards.

On the Atchison, Topeka & Santa Fe, in order that we may get the proper results, it has been found very essential that the tools be standardized and, whenever possible, drawings are made of the tools and then submitted to the tool-room foreman.

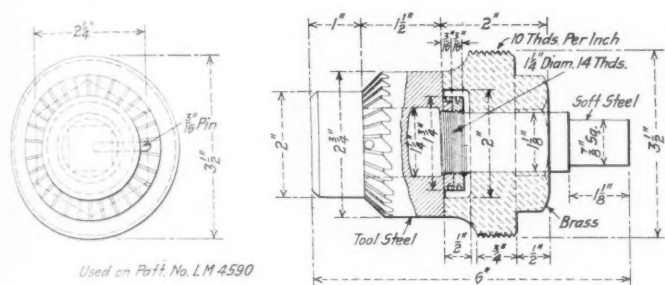


Fig. 5.—Boiler Check Reseating Tool

It is further found advisable that only tools which cannot be secured from the manufacturer for a reasonable price should be made in our tool room. It is not good practice for a railroad shop tool room to manufacture tools that can be secured from the manufacturers for the same price or less than it would cost to make them locally. In some shops such tools are made, but I consider it false economy due to the fact that there is a certain amount of loss incurred by the tool room, and when standard tools are secured from the factory all the possibility of loss is overcome, due to

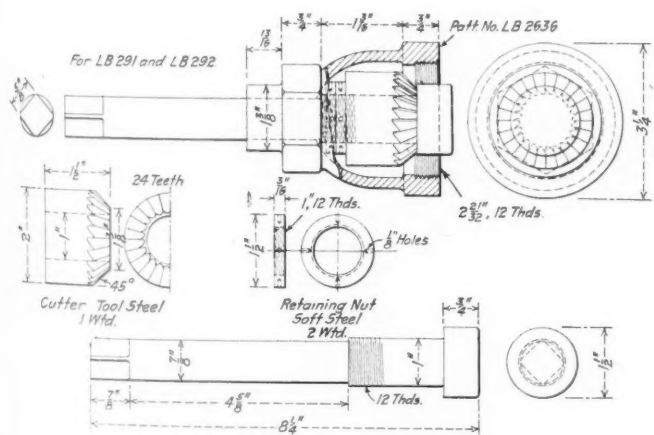


Fig. 6.—Reseating Tool for Blowoff Cock

the fact that all tools are furnished in first-class condition and free from flaws and defects.

There is a vast difference of opinion between railroads in regard to a standard locomotive frame reamer. The greatest difference seems to be in the length overall and in the taper. If a standard length and taper of locomotive frame reamers could be universally agreed on, it would be possible to eliminate the excess cost due to ordering the reamers as a special type from the manufacturer, as well as eliminating the carrying of many different lengths of reamers locally in the tool rooms.

For illustration, on the Sante Fe Lines a standard reamer has been fitted with a left-hand spiral flute and of a

standard length that will take care of the maximum and minimum requirements. Heretofore, there were a great number of different lengths which have been eliminated by standardization. By the adoption of the left hand spiral fluted reamer, the breakage has been reduced to about 20 per cent. While using the straight fluted reamer trouble was encountered due to the chipping out of portions of the flute and also chattering, while now this has all been eliminated, for the left hand spiral retards the reamer to such an extent that it does not gouge or seize, especially while reaming steel frames on locomotives. All our reamers are tapered 1/16 in. in 12 in., and I feel confident that with the proper co-operation of the mechanical heads on the various railroads throughout the United States, this point could be agreed upon.

DISCUSSION

Several questions were raised regarding standard forms of reamers. There was some difference of opinion regard-

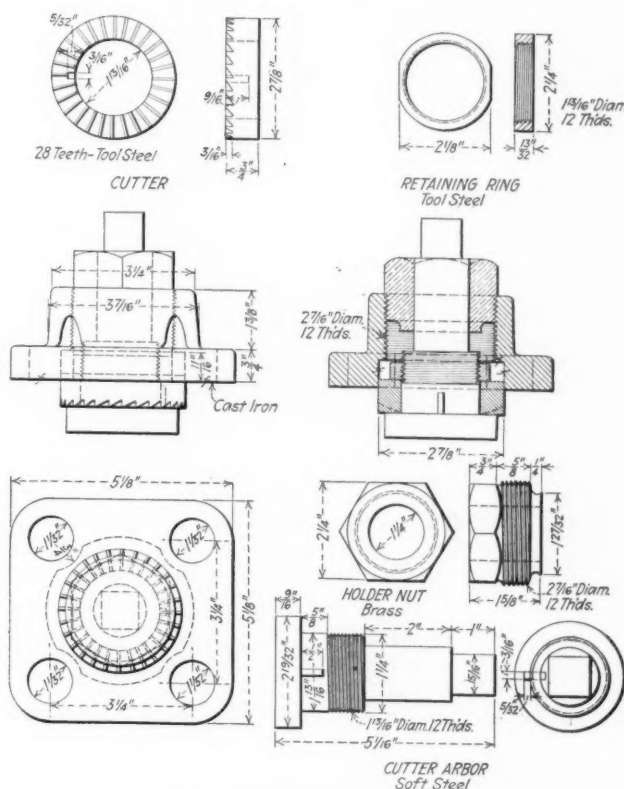


Fig. 7.—Reseating Tool for Blowoff Cock

ing the relative advantages of flute in the form of spirals having short and long pitches. The majority favored long spirals on reamers used with air drills, but the statement was made that the shorter spirals cut more rapidly, but required heavier thrust to feed them.

HEAT TREATMENT OF STEEL BY ELECTRIC FURNACES

BY HENRY OTTO

Tool Foreman, A. T. & S. F., Topeka, Kan.

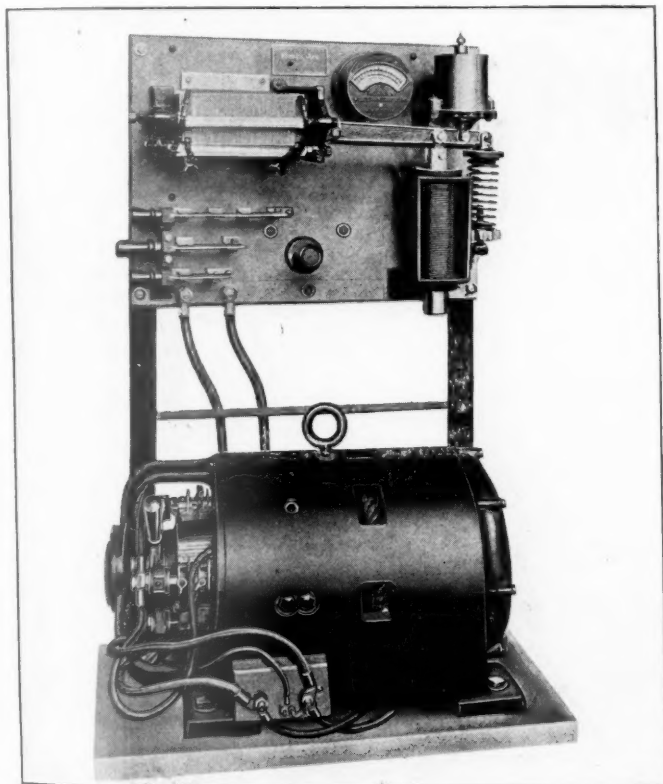
There are in use at the Topeka tool room two high temperature electric furnaces and an oil tempering bath. The furnace used for extremely high temperatures has a carbon resister and carbon top plate. The service life of these plates is about 125 hr., while the graphite bottom plate and electrode have a life of about 300 working hours. This furnace is expensive to maintain as the high heat used cracks the walls inside of the carbon plate. This must be repaired, and it takes some time for the cement to dry so

NEW DEVICES

THE PLASTIC-ARC WELDING OUTFIT

A new Plastic-Arc welding unit has just been brought out by the Wilson Welder & Metals Company, New York. This set is composed of a dynamotor and current control panel. The generator is flat-compound wound, and maintains the normal voltage of 35 on either no load or full load.

The control panel contains many new features. It has been designed to provide a constant-current controlling panel, small in size, of light weight, simple in operation and high in efficiency. The panel is of slate 20 in. by 27 in. and on it are mounted a small carbon pile, a compression spring and a solenoid working in opposition to the spring. The solenoid



The Plastic-Arc Unit

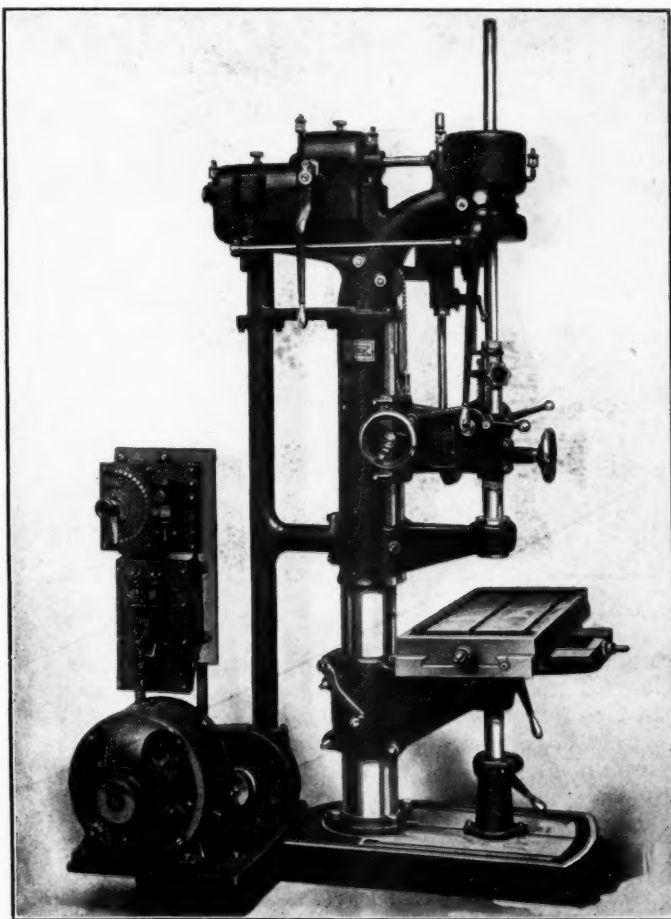
is in series with the arc so that any variation in current will cause the solenoid to vary the pressure on the carbon pile, thereby keeping the current constant at the value it is adjusted for. This gives a constant heat in the weld, and practically any metal can be welded without preheating or annealing.

Three switches on the panel provide an easy means of current adjustment between 25 and 175 amperes. The arrangement of the welding circuit is such that 25 amperes always flows through the solenoid when the main switch is closed whether the welding current is at the minimum of 35 amperes or the maximum of 175 amperes. The balance of the welding current is taken care of in by-pass resistances shunted around the solenoid.

This outfit can be furnished as a dynamotor unit, with standard motor characteristics, as follows: 110 volts 220 volts, DC or 220 440 volts, 60 cycle, two or three-phase, AC, also as a gasoline-driven unit, or it can be furnished without a motor, to be belt-driven. The normal generator speed is 1,800 r. p. m. The net weight of this new outfit in standard characteristics is 800 lb. with DC motor, 807 lb. with AC motor, 1,200 lb. with a gasoline engine, and 550 lb. as a belted outfit without motor. These new dynamotor sets can be mounted on a truck if desired, thus making a portable outfit.

THE FOSDICK HEAVY DUTY UPRIGHT DRILL

The Fosdick Machine Tool Company, Cincinnati, Ohio, have added to their line a new design of upright drilling and tapping machine. In general appearance the machine is



Variable Speed Motor Driven Machine with Compound Table

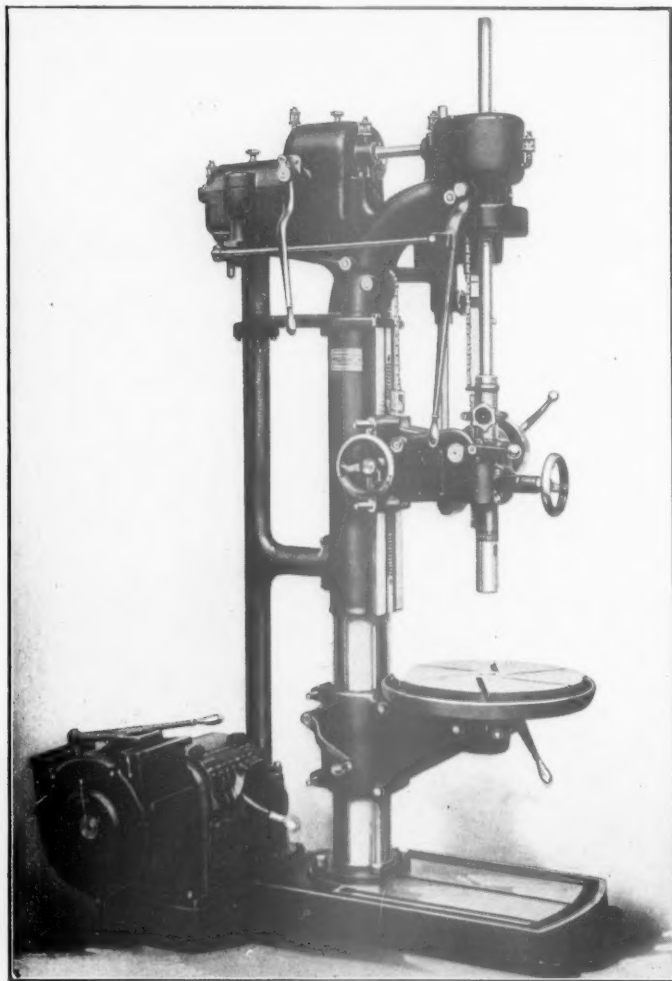
similar to the average modern upright drill, but the characteristics are entirely different. The gearing arrangements, frictions, feeds, quick return, etc., are similar in detail to

the corresponding parts which are being used on Fosdick heavy duty radial drills.

The illustrations show the regular constant speed belt driven machine with round table, and the variable speed motor driven machine with compound table with micrometer dial adjustments and the vertical milling support. These have a capacity of 25 in. diameter of work and the weight is about 2,350 lb., and they are driven by a 7½-hp. constant speed motor.

The base of this machine is surrounded by a channel draining to a large reservoir for drilling compound, and is so designed that bolts may be entered from either end of the T-slots.

The table arm has an unusually long bearing on the column and is internally ribbed similar to a bridge or roof truss



Constant Speed Belt Driven Machine with Round Table

which greatly increases the rigidity. The table is raised and lowered from either side of the machine, may be swung around the column to clear the base for large work and cannot accidentally drop when unclamped. The unique arrangement of the table T-slots allows them to terminate very close to the center, allows heavy ribs to run directly toward the hub, permits work of any shape to be securely clamped and prevents bolts from flying out should they become loosened while drilling.

The spindle head is raised and lowered by a handwheel, and not being burdened with the heavy feed arrangement, is perfectly counterbalanced. The spindle is provided with a depth gage and automatic trip which may be set to graduations in any position in the entire length of travel. A safety trip at the limit of traverse prevents accidents. The spindle quick return acts instantly, requires but one

hand to operate for sensitive drilling, for tapping, for rapid lowering or return of the spindle, with or without disengaging the power feed or the hand wheel feed.

Five feeds are obtainable ranging from .004 in. to .028 in. per revolution of spindle. The power feeds are all obtained by a single lever, within easy reach of the operator while seated, although it has been placed high enough not to interfere with the operating levers on the head. The hand feed may be fed ahead of the power feed without disengaging the latter. This is particularly advantageous in starting large drills.

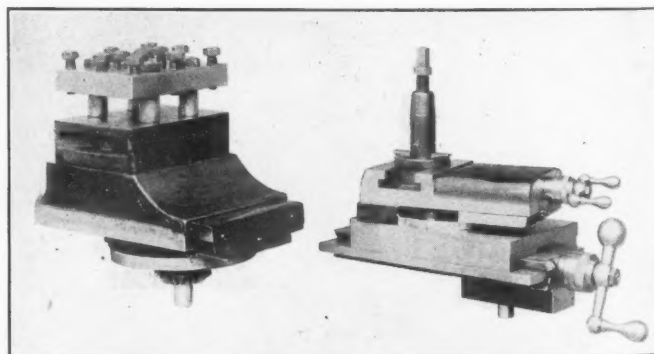
The friction reverse tapping mechanism is embodied in the construction of all machines, and being placed between the initial drive and the back gears, the power transmitted to the spindle is six times as great as in the spindle friction type. The bronze bearings are driven in bored holes, no babbitt metal being used in the machine. Ball bearings take the principal thrusts, including the spindle, both crown gears, the vertical driving shaft and friction bevel pinion, the feed worm and feed bevel gear. A metal chart showing speeds and feeds for high speed work is attached to each machine.

The machine is driven by a constant speed belt through the gear box, which furnishes correct cutting speeds for drills ranging from 3/16 in. carbon to 2½ in. high speed, with slower speeds for heavy tapping and for boring up to 5 in. diameter. Twelve spindle speeds are obtainable ranging from 49 to 550 r.p.m. Constant or variable speed motors may be supplied even after a belt driven machine is installed, as all styles of drive are interchangeable without requiring a special base. Pump and piping for drilling compound include a flexible tube to the point of the drill.

THE MULTI-CUT SERVICE LATHE

The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, have developed a semi-automatic lathe which has many distinctive features. As its name signifies, a number of tools are in operation at the same time. The machine is easily and quickly set up. There are no cams either fixed or adjustable to consider. One or more facing and turning operations can be performed simultaneously, one operator running several machines.

The work may be centered, held on arbors, expansion or



Multiple Tool Blocks

closer chucks, either pneumatic or hand-operated. The Multi-Cut is specially adapted to work that has been previously bored, reamed and rough turned on the turret or automatic lathe and remains to be finished, turned and faced.

PLAIN AND UNIVERSAL FACING ATTACHMENT

The plain facing attachment faces diameters up to the full swing of the lathe at right angles to the turning center. The feed of the facing slide is obtained entirely by the relative movements of flat and dovetail slides accurately gibbed and adjustable to compensate for wear. The facing

rest is fed towards the center of the lathe on a broad square lock slide to which it is accurately gibbed. The cross facing slide is movable along the bed and may be rigidly clamped to the shears in any desired position.

The facing bar slide carries the swivel guide bar which is fed along the bed at varying rates of speed.

A sliding shoe on the facing attachment slide engages the swivel guide bar which may be sent at any angle within the

the spacing of the binder screws. The tool block is adjustable to the center of the lathe and firmly clamped in position by two heavy bolts.

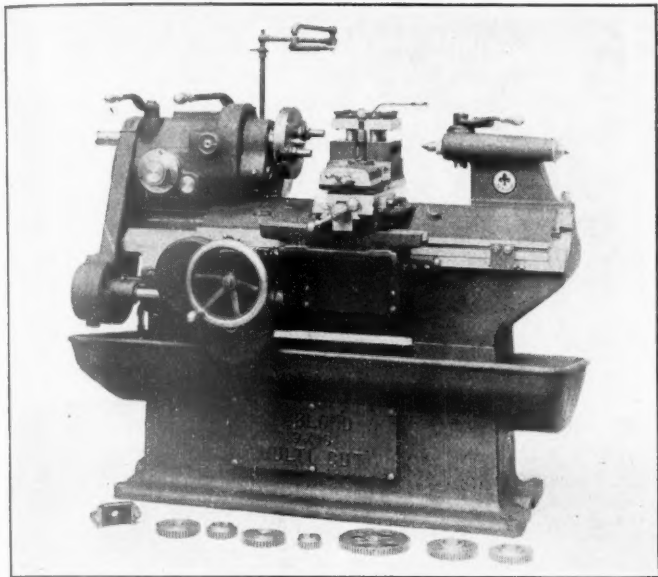
The universal facing attachment, as its name indicates, is adapted to angular facing operations on bevel gears, etc. When used in connection with a taper turning attachment the back and face angles can be turned simultaneously.

The swivel block is accurately graduated to facilitate angular settings and clamped firmly in the selected position by two heavy T slot bolts. The feed is through a pair of miter gears to the feed rack. Aside from this swivel feature the universal attachment and tool blocks are identical with the plain attachment.

Variations in feed for turning and facing slides are obtained by loose change gears applied to the feed bracket and worm box. The feeds read in "thousandths per revolution of spindle," and a simple, direct reading shows the change gear combinations and the resulting feeds.

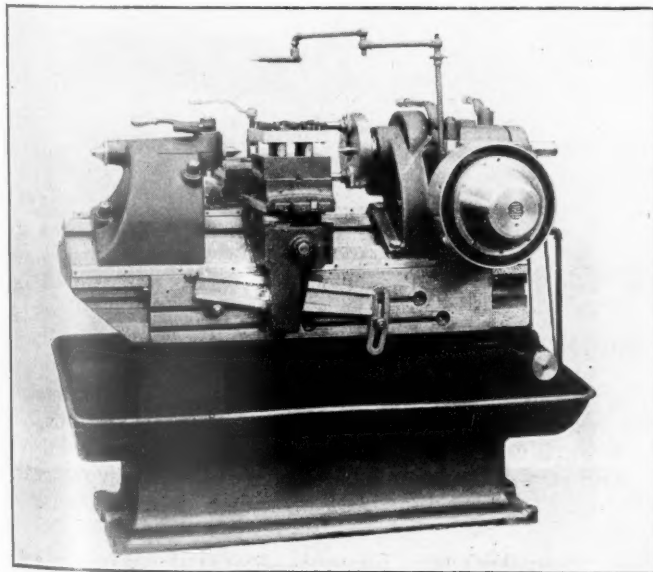
The feeds of the front slide are fixed by the change gears used while the feeds of the facing slide may be further varied with relation to the feed of the turning slide by the angularity given the swivel guide bar.

The feed worm and wheel are on fixed centers and encased in an oil tight gear box rigidly bolted to the bed. The feeds are tripped to a line by a sensitive acting positive



Multi-Cut Lathe No. 9

range, imparting a vertical motion to the shoe which is transmitted through a rack and pinion to the cross slide. By changing the angularity of the swivel guide bar the feed of the cross slide may be varied to complete its work at the same time as the turning slide or may be accelerated to finish ahead of the turning slide to permit of overlapping on form-

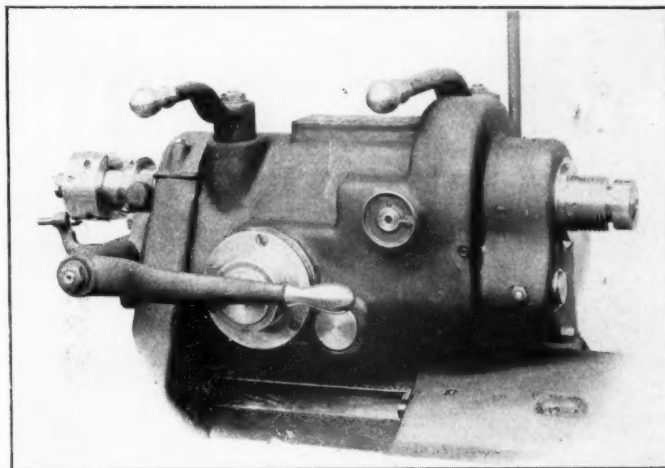


Rear View of Lathe Showing Right Angle Drive

ing and turning tools or it may be retarded to finish after the turning slide.

The feed to both turning and facing slide are tripped by the same clutch and will duplicate within close limits of accuracy.

The standard tool block furnished is arranged for multiple tools which can be held parallel or at any angle by reason of



Style B Headstock with Draw-in Attachment

jaw clutch heat treated and hardened engaging a similar clutch mounted on the worm wheel.

The feed drive is then through changeable gears and a pinion and bull wheel to the rack on the carriage. The drive to the facing slide is through similar change gears through the bed to the feed rack on the facing attachment slide on which the swivel guide bar is mounted.

The feed rack for both carriage and facing attachment is placed in the center of the slides imparting a feed without the usual binding action occasioned by applying the power off the center of the guiding shears.

The handwheel at the front of the worm box provides means of quickly returning the turning and facing slides to the starting position after the completion of each cut.

The worm wheel and clutch are running continuously in oil and the thrust of the worm is taken against ball thrust bearings.

The taper turning attachment consists of a rigid bracket bolted to the front of the bed, which carries an adjustable taper guide bar and a sliding shoe engaging the guide bar. The sliding shoe is attached to a cross slide imparting to it an "in" or "out" movement with relation to the angular setting of the guide bar. The guide bar may be set from straight to $4\frac{1}{2}$ in. taper per ft., either side of center and

clamped in the selected position by two heavy T slot bolts. The taper guide bar and sliding shoe may be replaced by a form plate and roller for the automatic duplication of irregular shapes.

The style B headstock is 6-speed selective geared, right angle driven. Three instantaneous changes are obtained with one lever, a shifter knob compounding these changes through a back gear for 6 speeds. The headstock is oil tight, the gears and friction clutches running in a continual bath of oil. The spindle bearings and driving clutch are also continuously flooded with oil from this same supply. The main friction clutch is mounted in the driving pulley, where it is operating at a constant high rate of speed and subject to little strain. It is of the multiple disc type running in oil, with a brake operating from the clutch handle. The driving pulley shaft is at 9 deg. to the spindle to permit of a more compact grouping of the machines. The spindle is fitted with taper bronze boxes, babbitt lined with means of adjustment for wear. The thrust is taken against ball thrust bearings.

A plain block rest, mounted on the cross slide, equipped with a single screw tool post and an adjustable positive cross stop, or a compound rest is supplied as conditions may require. The swivel is large in diameter and graduated in degrees for angular turning or taper boring. Adjustable taper gibs are provided to compensate for wear on the slides.

A quick lever acting tailstock is provided to permit of the quick removal and replacing of work with a single movement of the operating handle.

The center of the tailstock is brought into contact with the

massive and cast integral with the carriage. The head and tailstock are located and carried by the rear shear permitting the carriage to travel past them and keep the slides continuously covered.

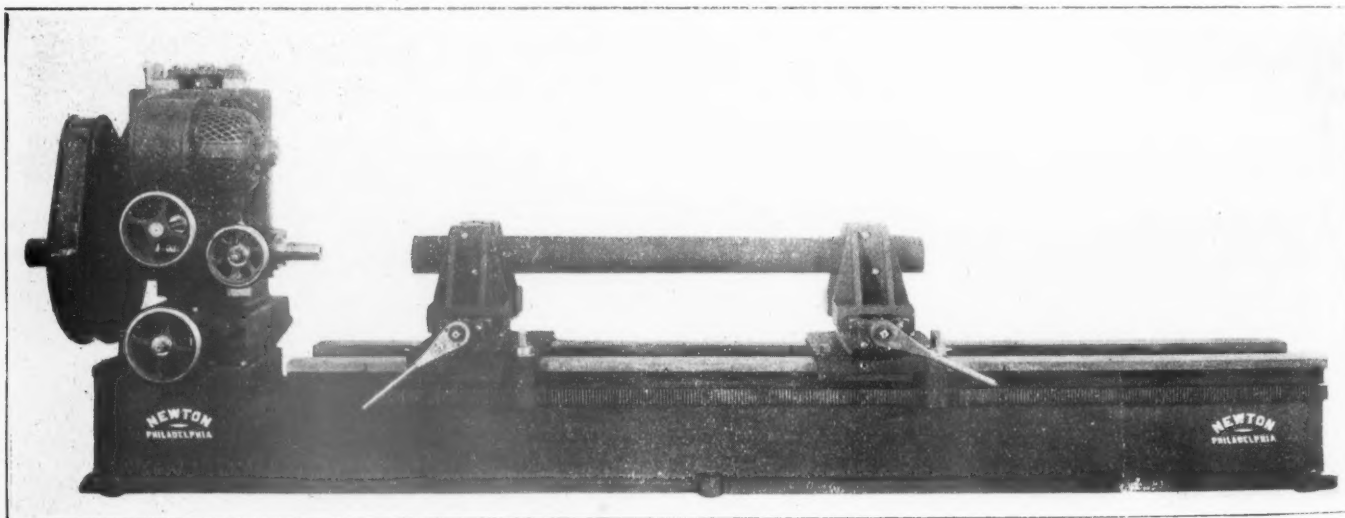
The Multi-Cut lathe is built in two sizes, No. 6, 6-in. swing, 10-in. capacity between centers, and No. 9, 9-in. swing, 16-in. capacity between centers. Several types of headstocks are supplied for each machine.

Some of the headstocks may be motor driven. The motor is attached to a motor plate hinged from the cabinet base of the machine and provided with an adjustable jack for maintaining the desired belt tension.

A constant speed motor A.C. or D.C. running preferably 1,200 r.p.m. is recommended.

NEWTON CENTERING MACHINE

The centering machine shown in the illustration is a recent development of the Newton Machine Tool Works, Philadelphia, Pa. It is designed for centering rough and irregular castings. The spindle is of forged steel 3 in. in diameter, running in bronze bushed bearings and having an 8-in. horizontal hand feed. The maximum distance from the center of the spindle to the top of the base is 17½ in. and the minimum distance 13½ in., giving a vertical adjustment of 4 in. The spindle also has a cross adjustment of 4 in., equally divided each side of the center line of the work. Two universal centering vises of the interlocking type and adjustable on the bed are supplied with the machine. The jaws are adjustable by means of a screw giving



The Newton Centering Machine with Round Stock in the Vises

work at any desired pressure, by a conveniently placed lever, further movement of the same lever rigidly locking the tailstock barrel and clamping the spindle.

The bed is of a special anvil section, with broad slides for the carriage and bearings for the head and tailstock, and is strongly ribbed internally and mounted on a cabinet base, in which the pan and chamber for cutting compound is cast. The pan becomes an integral part of the bed, and greatly stiffens the entire machine. A strainer separates the chips from the cutting compound, which flows back to the base of the machine. A geared rotary pump and piping for circulating the compound is supplied as regular equipment.

A cover plate is provided for cleaning out the base.

The carriage is a broad slide extending practically the full length of the bed and scraped to a bearing its entire length. The cross slide for mounting the compound or plain rest is

a capacity for stock from 2 in. to 12 in. in diameter and of any desired length. The alinement of all of the movable parts is maintained by adjustable tapered shoes. The drive is by direct connected motor through bronze driving gear. The base of this machine is 22 in. wide and 16 ft. long.

MACHINE TOOLS IN FRANCE.—Before the war the majority of machines imported into France came from Germany. In 1913, France imported 28,000 machine tools at a value of 52,000,000 francs, 50 per cent of which came from Germany. During the same year 11,000 machine tools, valued at 16,000,000 francs, were exported from France. Machine tools to the value of 65,000,000 francs were produced in France in 1913. It is planned that the French aeroplane factories will be converted into plants for the manufacture of machine tools.—*Le Génie Civil*.

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION
with which the AMERICAN ENGINEER was incorporated)

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY

EDWARD A. SIMMONS, *President* HENRY LEE, *Vice-President and Treasurer*
L. B. SHERMAN, *Vice-President* SAMUEL O. DUNN, *Vice-President*
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Chicago: Transportation Bldg. Cleveland: Citizens' Bldg.
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London: 85 Fleet Street, E. C. 4.
Subscription Agents for Great Britain and Egypt: The Dorland Agency, Ltd.,
16 Regent Street, London, S. W. 1.
Cable Address: Urasigmech, London.

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Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Subscriptions, including the eight daily editions of the *Railway Age*, published in June, in connection with the annual convention of the American Railroad Association, Section III—Mechanical, payable in advance and postage free: United States, Canada and Mexico, \$2.00 a year; Foreign Countries, \$3.00 a year; Single Copy, 20 cents.

WE GUARANTEE, that of this issue 11,100 copies were printed; that of these 11,100 copies 10,341 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 213 were mailed to advertisers, 29 were mailed to employees and correspondents, and 497 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 95,710, an average of 9,571 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Seaboard Air Line has decided to use oil fuel in the locomotives on its lines south of Hamlet, N. C., and has contracted for a supply of oil from Mexico.

A plan for preventing strikes, similar to that embodied in the Canadian law, is provided in a bill, H. R. 9062, introduced in Congress by Representative Wood of Indiana. It provides for the appointment by the President of commissions to investigate labor controversies and would prohibit a strike or lockout pending the conclusion of any investigation by a commission.

The Central Railway Club's annual outing at Grand Island, N. Y., on August 28, was voted one of the most enjoyable in the history of the organization by the 160 members who attended. A brief business session was held, during which announcement was made that the campaign for a membership of 1,000 has been progressing so well that only about 100 more are required to bring the membership list up to the desired number.

Dr. John D. Robertson, health commissioner of the city of Chicago and head of the Smoke Prevention Bureau, recently declared, in connection with a smoke prevention drive he is now conducting, that smoke from locomotives in the city of Chicago must be eliminated. A recent newspaper statement quotes him as saying: "I don't care how the railroads end the smoke nuisance. They can use smokeless coal, change their boilers or do anything they desire, but the smoking engines must stop. No excuses will go." Railway executives, master mechanics, and locomotive firemen and engineers were called into conference in Doctor Robertson's office and plans were formulated for reducing the smoke nuisance insofar as the railroads entering Chicago are concerned.

A delegation representing the railroad shopmen recently called upon Governor J. P. Goodrich of Indiana and urged the establishment of a state mediation committee to investigate strikes and threatened strikes before calling out state troops "unnecessarily." It was pointed out that great expense could have been saved the state had troops not been sent to Hammond, Ind., to end the recent disorders resulting from the strike of employees at the plant of the Standard Steel Car Company. This contention, however, was not concurred in by the governor, who acted without hesitation

when local authorities at Hammond admitted their inability to preserve order. Governor Goodrich has taken the matter under advisement and will hold further conferences with the shopmen's representatives.

Arbitration Rules

The Arbitration Committee of the Mechanical Section of the American Railroad Association, calling attention to requests for interpretations and for arbitrations that are not prepared in accordance with the rules, promulgates the following general rules:

1. Requests for interpretation of the Rules of Interchange must be signed personally by the chief mechanical officer of the railroad or company. Questions received from car foremen, bill clerks, inspectors and others in a minor capacity, will not be considered. Many of the questions raised by these minor officers could and would be settled by the chief mechanical officer without being referred to the arbitration committee.
2. In presenting requests for interpretation, all facts in the case should be clearly stated, and, wherever possible, repair cards and other records involved should accompany the letter.
3. Where the question for interpretation is the result of a controversy with another company, the name of the other company should be given in order that the committee may, if necessary, request additional information from both parties to the dispute. Several requests for interpretation of the rules have been presented recently that were in reality disputes that should have been prepared as arbitration cases.
4. All cases presented for arbitration should be prepared in accordance with provisions of Interchange Rule 123. Both parties to the dispute should join in presenting the case. The entire file, including original repair cards, joint evidence certificates, etc., should accompany the prepared statements.

Safety Appliances and Loading Rules

The Interstate Commerce Commission has extended the effective date of its latest order requiring the railroads to make their freight cars conform to its standards of safety appliance equipment, from September 1, 1919, to March 1, 1920. This was done at the request of the Railroad Administration and the American Railroad Association.

The Mechanical Section of the American Railroad Association has therefore changed the effective date of sections G and K of Rule 3 of the 1918 Code of the Rules of Interchange from September 1, 1919, to March 1, 1920. A correction has also been made in Supplement No. 1 to the loading rules. In Figs. 42 and 46, accompanying this supplement, half-inch bolts are shown passing vertically through the ends of the clamping pieces to prevent splitting. These bolts should be applied horizontally instead of vertically, as shown in the drawings.

American Society for Testing Materials

Society headquarters have been established by this association at the Engineers' Club building, 1316 Spruce street, Philadelphia, Pa. Offices were heretofore at the University of Pennsylvania.

The membership of the society has passed the 2,500 mark, now numbering 2,538. While the growth of the society has been steady, it has never been as rapid as during the present year, during the first eight months of which 313 new members were enrolled.

In accordance with the policy inaugurated in 1917 the tentative standards of the society will be published in Part I of the proceedings, and will also be published in a separate volume for the convenience of those who may wish to use them in that form. The 1919 edition will contain the 62 specifications, tests, methods and definitions which have been accepted by the society as tentative, of which 23 are new this year and nine have been revised. This volume will comprise about 350 pages, and is expected to be available for distribution in November, about a month earlier than the proceedings.

Conditions Affecting Trade with Siberia

Numerous inquiries have been received in Washington regarding the conditions and regulations surrounding trade with Siberia. In order to clear up certain misapprehensions regarding trade with this region the following notes have been compiled by the Foreign Trade Advisers' Office of the Department of State.

The so-called Allied Purchasing Committee, of which Capt. George E. Spengler is chairman, is a subcommittee of the Interallied Technical Board of the Committee for Supervision of the Chinese Eastern and Transsiberian Railways. This committee will make purchases of supplies and materials for the Siberian railways by direction of John F. Stevens, president of the Technical Board of the Interallied Committee. All orders for material to be purchased in the United States for use in connection with the railways will be placed by the committee through the Director General of Military Railways, War Department. This committee has nothing to do with purchases of other than railway material and supplies. The Director General of Military Railways is in close touch with all American manufacturers and is in a position to expedite orders for badly needed supplies.

Equipment Conditions on Russian Railways

In January, 1916, there were still 72,743, and in January, 1917, 70,118 freight cars, running daily; in January, 1918, this number had decreased to 16,644, and in January, 1919, it had sunk to 13,193 cars. The working capacity of the engines has fallen off in a similar degree. In 1918 they were capable of travelling only about 35 miles per day. The workshops were obliged to hand over important parts of their machinery to the munition workshops. This absence of necessary machinery and instruments is especially felt in the locomotive shops. The number of railway engines out of repair amounted in March, 1916, to 17.3 per cent; March,

1917, 23 per cent; March, 1918, 35.3 per cent; March, 1919, 52.4 per cent. The number of freight cars out of repair amounted in March, 1916, to 3.4 per cent; March, 1917, to 5.4 per cent; March, 1918, to 9.1 per cent; March, 1919, to 18.8 per cent.

The railway bridges and railway lines are also in a state of decay and have in some cases been badly damaged as a result of civil war. Little is heard in the press of the numerous accidents that take place in consequence of trains running off the lines. The work of repair is often hindered by the passive resistance of railway workers antagonistic to the Soviet regime. For lack of raw material, the number of engines built in 1918 was considerably reduced. In 1917, 520 locomotives were able to be built in Russian foundries, but only 191 in 1918, 152 of which were intended for goods traffic, and only 39 for passenger trains. Since the taking of the Urals by Kolchak's army, the production of pig-iron for rails has entirely ceased as far as the requirements of Soviet Russia are concerned and few new lines can be built.

Lack of Railroad Facilities Hampers All Eastern Europe

"Transportation is the chief difficulty alike in relief work and reconstruction throughout eastern Europe. Adequate railways in the Balkan States would unlock great natural resources and open up endless possibilities. The next decade in this part of the world must be an era of railroad building if the people are to live and prosper."

This paragraph, quoted from the monthly report of the American Red Cross mission at Bucharest, says a correspondent to the Philadelphia Public Ledger, points out the most serious problem which faces the new governments of the countries of eastern Europe. There are at present fewer than 100 trains in the whole of Rumania and no more than 400 locomotives, counting every available engine—good, bad and indifferent.

The most luxurious train in Rumania today includes one first-class coach and three coaches of a nondescript third-class type. Thousands of men are at work repairing the lines, but their work is hampered by lack of material. Bridges by the score were destroyed during the war by both Rumanians and Germans. These have been repaired in part only. Trains in Rumania creep along at one-third the old-time speed, with peasants and other travelers riding wherever they can find foot room, either on the steps of the coaches, on the couplers or on the roof.

As a rule, about 50 persons are accommodated on the roof of each coach. This is fine enough in fair weather, until the train pulls into a tunnel, when the roof-riders and those on the steps are half asphyxiated by the thick black coal smoke that pours from the locomotive. The locomotives used fuel oil before the war, Rumania being an oil-producing country; but the Germans took away all the oil burners from the engine fire-boxes and the locomotives have to get along now as best they can with whatever fuel is available.

It is reported in Berne that more than 50 German and American locomotives will shortly be sent from France through Switzerland to Rumania and Poland to supply the urgent need for engines in those countries. Rumanian en-

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian.....	Oct. 14			W. A. Booth.....	131 Charron Street, Montreal, Que.
Central.....	Nov. 13	Annual dinner.....		H. D. Vought....	95 Liberty Street, New York.
Cincinnati.....	Nov. 11	Annual banquet and entertainment.....		H. Boutet.....	601 Carew Building, Cincinnati, Ohio.
New England.....	Oct. 14	Shop Efficiency.....	Frank McManamy..	W. E. Cade, Jr....	683 Atlantic Ave., Boston, Mass.
New York.....	Oct. 17	Utilization of Freight Cars.....	W. C. Kendall.....	H. D. Vought....	95 Liberty Street, New York.
Pittsburgh.....	Oct. 23	Annual meeting and election of officers.....		I. D. Conway.....	515 Grandview Avenue, Pittsburgh, Pa.
St. Louis.....	Oct. 10	Can the Railway Problem Be Solved?.....	S. O. Dunn.....	B. W. Frauenthal.	Union Station, St. Louis, Mo.
Western.....	Oct. 20	Design, Inspection and Maintenance of Freight Car Equipment.....	L. K. Silcox.....	J. M. Byrne.....	547 West Jackson Blvd., Chicago.

gine drivers have already arrived in France (says a (London) Times correspondent) to take charge of some of these locomotives.

Shortage of German Rolling Stock

The Technical Supplement to the Review of the Foreign Press (London) publishes an extract from the Kolnische Zeitung of June 15, giving an account of the causes for the shortage of German rolling stock.

"In the Ruhr district there are renewed complaints as to the 'shortage of wagons.' This expression is generally used to express a state of things for which it is not really appropriate. There seems rather to be a shortage of locomotives to bring the wagons to the places where they are required than a shortage of wagons themselves. The terms of the armistice, requiring the surrender of so many locomotives, are responsible for this.

"The Prussian Railway Administration meanwhile has given orders for 2,463 new locomotives, and the engine works are doing their best to deliver them. On the whole they have executed the orders satisfactorily. The reason why the stock of locomotives is not increasing is explained by the bad condition of the old engines, the result being that every week as many come to be repaired as have been sent out from the repair shops. There is an incontestable shortage of passenger carriages. The Railway Administration has consequently ordered 2,896 coaches and 45,000 freight cars. The total orders given amount to 2,000,000,000 marks. But even by these orders the stock of locomotives and wagons is brought to its proper level, the whole difficulty is by no means solved. There is not a trained personnel available to enable such a stock of wagons to be utilized as fully as necessary. This problem is rendered more acute by the eight-hour day difficulty, while the abolition of piece-work delays the repairs to the rolling stock. Then there are the constant interruptions to work by elections, meetings and councils. The unsatisfactory state of things in the railway world is another of the 'achievements' of the revolution."

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meeting, and places of meeting of mechanical associations:

- AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.
- AMERICAN RAILROAD ASSOCIATION, SECTION III—MECHANICAL.—V. R. HAWTHORNE, 431 South Dearborn St., Chicago.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.
- AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreuccetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawler Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.
- CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koenke, secretary, Federal Reserve Bank Bldg., St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—H. J. Smith, D. L. & W., Scranton, Pa.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.
- MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.
- MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.
- NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.
- RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.
- TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

W. P. CHRISTIE has been appointed superintendent of safety of the Toledo, St. Louis & Western, with headquarters at Frankfort, Ind., succeeding F. E. Myers, resigned.

WILLIAM D. HANNAH, chief fuel inspector of the Grand Trunk, with headquarters at Montreal, Que., has retired after 40 years of continuous service with that road.

A. H. KENDALL has been appointed master mechanic of the Quebec district of the Canadian Pacific, with office at Montreal, Canada, succeeding C. A. Wheeler, transferred.

R. W. LIPSCOMB, assistant superintendent on the Galveston, Harrisburg & San Antonio, at El Paso, Texas, has been appointed chief assistant mechanical superintendent on the Southern Pacific Louisiana Lines and Texas Lines, with headquarters at Houston, Texas, succeeding J. P. Nolan, retired on pension.

J. J. MAGINN, formerly master mechanic of the Cincinnati Northern at Van Wert, Ohio, has been appointed superintendent of motive power of the Lake Erie & Western, with headquarters at Lima, Ohio, succeeding George J. Duffey, deceased.

CAR DEPARTMENT

C. J. NELSON has been appointed general foreman of the car department on the Chicago & North Western, in charge of the Galena and Wisconsin divisions and Chicago Terminals, succeeding L. R. Wink.

L. R. WINK, general foreman of the car department on the Chicago & North Western, has been appointed assistant superintendent of the car department, with offices at Chicago.

SHOP AND ENGINEHOUSE

L. B. SHEARER has been appointed tank shop foreman of the Erie Railroad at Huntington, Ind., succeeding J. E. Shavey, transferred.

PURCHASING AND STOREKEEPING

F. A. HAMILTON has been appointed purchasing agent of the Colorado Springs & Cripple Creek District Railway, with headquarters at Colorado Springs, Colo.

T. C. HOPKINS has been appointed local storekeeper of the Baltimore & Ohio at Cleveland, Ohio, succeeding L. F. Ryan, resigned.

J. A. LAUGHLIN, storekeeper of the New York Central, Lines West of Buffalo, at Elkhart, Ind., has been appointed an assistant general storekeeper at Collinwood, Ohio.

W. A. MILLER has been appointed division storekeeper on the Southern Railroad, with office at Spencer, N. C., succeeding C. J. Norman, deceased.

HENRY STEPHENS has been appointed an assistant general storekeeper on the New York Central, Lines West of Buffalo, with headquarters at Collinwood, Ohio.

OBITUARY

EDWARD SALLEY, supervisor of locomotive operation on the New York division of the Erie Railroad, died on August 13 at his home in Jersey City, N. J., at the age of 74. Mr. Salley had been in the employ of the Erie for more than 50 years, for the past 15 years as supervisor of locomotive operation.

SUPPLY TRADE NOTES

Richard Pintsch, inventor of the Pintsch gas lighting system, is reported to have died recently at Berlin, Germany, at the age of 80.

The American Locomotive Company is planning to carry out improvements to double the capacity of its steel plant at Chester, Pa. The work will cost about \$1,000,000.

The Hutchins Car Roofing Company, Chicago, has opened an office in the Railway Exchange building, St. Louis, Mo., in charge of Charles W. Pace as district sales manager.

S. B. Andrews has resigned as mechanical engineer of the Seaboard Air Line at Portsmouth, Va., and has been elected vice-president and general manager of the Union Iron Works, Inc., Berkley-Norfolk, Va.

George A. Cooper, of the sales and advertising department of the United States Graphite Company, Saginaw, Mich., has been appointed advertising and export manager of the Detroit Lubricator Company, Detroit, Mich.

Paul Mitchell has resumed his duties as traveling representative of the Chicago sales office of the Independent Pneumatic Tool Company, Chicago. Mr. Mitchell was a sergeant in the American Expeditionary Forces in France.

H. W. Johns-Manville Company, New York, has commenced excavating for a large plant at Waukegan, Ill. No contracts have been let for the building itself as the type of construction and the specifications have not been fully decided upon.

E. M. Cutting, Pacific coast manager for the Edison Storage Battery Company, with office at San Francisco, Cal., has been appointed manager of the railroad department with office at Orange, N. J. Mr. Cutting entered railway work in 1888 in the signal department of the Southern Pacific. In 1898 he was appointed supervisor of signals for the Western division and in 1902, in addition to his duties in the signal department, he was given charge of all electric train lighting. In 1908 he became engineer of train lighting, heating and ventilation, resigning in 1912 to become Pacific coast manager for the Edison Storage Battery Company, which position he held until his recent promotion. Mr. Cutting was instrumental in initiating the movement which culminated in the formation of the Association of Railway Electrical Engineers, of which he was elected president in 1909.



E. M. Cutting

D. B. Fulton, assistant to the chief engineer of the American Brake Shoe & Foundry Company, New York, has entered the sales department of the Railway Steel Spring Company, Chicago, where he will be associated with N. C. Naylor, sales agent in the Chicago office.

The Carborundum Company, Niagara Falls, N. Y., has opened a branch office and warehouse in the Burkhardt building at Second and Larned streets, Detroit, Mich. This branch is under the management of Anthony Dobson, who will have charge of the Detroit sales district.

The Pollak Steel Company, Cincinnati, Ohio, has appointed the Lake Shore Engine Works, Marquette, Mich., as its agent for the upper peninsula of Michigan, and the E. R. Hensel Steel & Copper Company, Security building, St. Louis, Mo., agents for the St. Louis district.

George W. Bender, district manager in charge of the New York office of Mudge & Co., Chicago, has been promoted to manager of sales and service with headquarters in Chicago. Mr. Bender was born at Pittsburgh, Pa., on August 20, 1884. At the age of 17, he entered the engineering department of the Pressed Steel Car Company of that city. In 1906, he accepted a position with the American Locomotive Company, where he had charge of the extra work order department. In 1910 he became associated with Mudge & Co. as chief draftsman, and subsequently was given charge of the mechanical department. Later he was made assistant to the vice-president, a position he held until his appointment in April, 1918, as eastern manager in the New England and Atlantic Coast states, in which capacity he served until his recent promotion.



George W. Bender

Paul Sutcliffe, advertising manager of the Edison Storage Battery Company, Orange, N. J., has been appointed manager of the industrial truck and tractor department of the same company. Mr. Sutcliffe has been with the Edison Storage Battery Company for the past five years.

The Bucyrus Company, South Milwaukee, Wis., announces that it has opened a Cleveland office at 808 American Trust building in charge of E. G. Lewis, formerly with the New York office of the Bucyrus Company and more recently president of the New Jersey Slag Products Company, of Dover, N. J.

The Chicago Pneumatic Tool Company, Chicago, has removed its Cincinnati (Ohio) office from the Mercantile Library building to the Walsh building, Pearl and Vine streets, where a service station with a complete stock of pneumatic tools, electric tools, air compressors, oil engines, rock drills and repair parts will be maintained.

E. G. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Company, Cleveland, Ohio, has recently returned from a three-months' visit to England and the Continent, where he has made a thorough trade investigation in conjunction with the Cleveland Twist Drill Company of Great Britain, Ltd., London, the European branch of the Cleveland Twist Drill Company.

John D. Rogers has received his discharge as captain of engineers in the office of the director general of military railways in Washington, D. C., and is now in the foreign sales department of the Baldwin Locomotive Works at Philadelphia. Prior to entering the army, Mr. Rogers was shop

superintendent on the Virginian Railroad, having previously served on the Chesapeake & Ohio, the Pere Marquette, and the Union Pacific railroads.

Charles Riddell has resumed his duties as manager of the Chicago office of the Baldwin Locomotive Works and the Standard Steel Works Company. Mr. Riddell, who was formerly manager of the Chicago office, has been serving as assistant secretary and treasurer in the financial department at the Philadelphia, Pa., office for the past year and a half. Arthur S. Goble, manager of the Chicago office of the Baldwin Locomotive Works, has been transferred to the St. Louis, Mo., office.

John Kelly, who for a number of years was New York district manager of the Edison Storage Battery Company, has been appointed general sales manager of the company, with headquarters at Orange, N. J. This promotion for Mr. Kelly follows closely upon his promotion, on July 1 of this year, to the position of assistant general sales manager. Mr. Kelly brings to his new position the experience of a long and varied career in the storage battery, electric vehicle and accessory business. For nine and one-half years he was district manager of the New York office of the Edison Storage Battery Company. Before that he had been a salesman for the Westinghouse Storage Battery Company for two years, for the Swinehart Tire & Rubber Company for three years, for the Firestone Tire & Rubber Company for two years, and for the New York Edison Company for nearly four years.



John Kelly

Major H. C. Bayless, formerly mechanical engineer on the Minneapolis, St. Paul & Sault Ste. Marie and the Great Northern, but more recently chief inspector of ordnance for the War Department at the Standard Steel Car Company's plant at Hammond, Ind., has been appointed combustion engineer and manager of the Superior Pulverizer Company, Chicago, in which capacity he will have entire charge of engineering and sales and general supervision of coal installations.

The Fastfeed Drill & Tool Corporation, recently incorporated under the laws of the state of New York with an authorized capital of \$500,000, has purchased the factory, together with the business and good will, of the McCarthy Drill & Tool Corporation, Toledo, Ohio. John D. McGrath, formerly treasurer of the McCarthy Drill & Tool Corporation, is managing director of the new organization, which will continue to operate the plant in Toledo. Additions to the present equipment are planned for the near future.

F. H. Crawford, sales manager of F. H. Niles & Co., Inc., Woolworth building, New York, has been appointed secretary, and J. E. Haetten, assistant sales manager has been appointed sales manager. G. P. Goodman, who for several years has represented the Hisey-Wolf Machine Company, Cincinnati, Ohio, in the east, becomes associated with the F. H. Niles & Co., Inc., having charge of its portable tool department. This company handles in the east the Hisey-Wolf line of electric machine tools, and the Canton pneu-

matic hammers and drills made by the Pittsburgh Pneumatic Company, Canton, Ohio.

The Baldwin Locomotive Works and the Standard Steel Works Company have opened a branch office in the Merchants National Bank building, St. Paul, Minn. Henry Blanchard, sales representative in the Chicago office of the concerns, has been appointed manager of the new branch offices. Mr. Blanchard entered the service of the Baldwin Locomotive Works and the Standard Steel Works Company in the latter part of 1915, in the Philadelphia office. In April, 1919, he resigned as assistant to the vice-president in the Philadelphia office and was transferred to the Chicago office as sales representative. Prior to entering the service of these companies he served as sales engineer of the American Steel Foundries, with office in Chicago.

The Electrolytic Oxy-Hydrogen Laboratories, Inc., announce the formation of a sales and manufacturing company under the name of the Electrolabs Company. The Electrolytic Oxy-Hydrogen Laboratories, Inc., will continue in charge of the laboratories and maintain a technical supervision over the work of the new company. The general offices and works of both companies have been moved from Dayton, Ohio, into larger quarters at 2635 Penn avenue, Pittsburgh, Pa. The general sales offices are being continued at 15 William street, New York City, and branch sales offices have been opened in the Morris building, Philadelphia, and in the Merchants Exchange building, San Francisco. I. H. Levin continues in charge of technical and research work, and D. J. Tonkonog in general charge of sales.

John F. Schurch, operating vice-president of the T. H. Symington Company Lincoln Park Works, Rochester, N. Y., has been elected vice-president in charge of all western sales, with headquarters in Chicago. Mr.

Schurch graduated from the University of Minnesota in 1893. He entered the service of the Minneapolis, St. Paul & Sault Ste. Marie the same year, serving consecutively in the office of the auditor, and of the general superintendent and in the transportation departments, resigning in 1905 after obtaining the position of chief clerk to the vice-president. From 1905 until 1914 he was associated with the Railway Ma-



J. F. Schurch

terials Company of Chicago. In February, 1914, he was elected vice-president of the Damascus Brake Beam Company with office in Cleveland, Ohio, and in June, 1914, he was elected president of that company, which position he resigned the same year and was elected vice-president in executive charge, under President C. H. Symington, of the Symington interests in the production of 75 mm. guns, shells and forgings. The Symington interests included the Symington Anderson Company, the Symington Machine Corporation, the Symington Forge Corporation, with office in Rochester, N. Y., and the Symington Chicago Corporation, with office in Chicago. In August, 1918, in addition to these offices, he was made operating vice-president of the T. H. Symington Lincoln Park Works. Mr. Schurch is also vice-president of the Railway Supply Manufacturers' Association.

CATALOGUES

DATA ON SHAFTS.—Three charts giving the relations for any shaft between power, shaft diameter, torsional stress and speed have been prepared by one of the engineers of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, which has published them in bulletin No. 22 for the use of engineers and draftsmen.

COLOR CHART FOR HEATING STEEL.—The Onondaga Steel Company, Syracuse, N. Y., has prepared a graphic color chart containing directions for cutting "ON" high speed steel for tool lengths, for forging and hardening forged tools, milling cutters and finished tools, and for tempering and annealing, with the temperatures for the different operations shown in color.

STEAM MOTOR.—A description of its steam motor is given in bulletin No. 5, issued by the Steam Motors Company, Springfield, Mass. The bulletin contains 23 pages of descriptive material and many illustrations showing the parts and construction of the motor and the method of its application. The motor is a steam turbine designed for use in direct connected centrifugal pump and blower units.

MACHINE TOOL EQUIPMENT.—A number of two-page bulletins have been issued by the Bilton Machine Tool Company, Bridgeport, Conn. These bulletins are bound in a cover with punched holes to which others may be added from time to time and each briefly describes and illustrates a machine made by this company. These include gear milling and hobbing machines, automatic milling machines, automatic cam feed drill presses, drilling and riveting machines, etc.

FANS, BLOWERS AND EXHAUSTERS.—The various types of blowers, exhausters and fans manufactured by the Buffalo Forge Company, Buffalo, N. Y., are described in catalogue No. 400, with illustrations and tables of specifications. Diagrams and illustrations of countershafts designed for use with these blowers and exhausters are shown, together with dimensions and price lists. This booklet, consisting of 35 pages, contains information of special value to fan users.

LEATHER BELTING.—A 20-page pamphlet issued by the Leather Belting Exchange, Philadelphia, Pa., contains information obtained during the course of an investigation on power transmission by belting conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh for the Leather Belting Exchange. The booklet is entitled "A Study of Various Types of Belting," and was written by Professor Ernest D. Wilson of the Mellon Institute. It describes the equipment used in the tests and the results obtained, and is illustrated with several photographs.

BOILER FEED CONTROL.—An eight-page bulletin, embodying specifications for the Copes system of boiler feed regulation, has been published by the Northern Equipment Company, Erie, Pa. A cover is provided with punched holes for adding future bulletins or specifications that will be published by the company. The bulletin discusses the principle and operation of the regulator and its mechanical construction, heat storage, reduction of furnace temperature fluctuations on sudden load changes, service performance, and the Copes steam pump governor. It contains a number of charts and photographs.

STEAM JET AIR PUMPS.—Preliminary bulletin No. 113, illustrating and describing the Wheeler steam jet air pump is now being distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J. This steam jet air

pump has two or more steam jets working in series with a condenser between the jets, which permits more efficient operation. The pump is applicable to jet condensers, as well as to surface condensers. The bulletin explains the operating principles, gives reasons for high efficiency, describes the inter-condenser and shows an operating test curve. It includes a cross sectional drawing and shows how to connect double machines or triple machines to surface condensers.

PNEUMATIC TOOLS.—In a temporary catalogue, containing 48 pages, issued pending the publication of a larger book, the Keller Pneumatic Tool Company, Grand Haven, Mich., shows briefly its line of pneumatic tools, including valve and valveless types of rotary and piston drills, which are new additions to the line. All models of Keller-Made Master-Built chipping hammers, riveting hammers, holders-on, dolly bars, jam riveters and sand rammers are illustrated and described, with detailed specifications and information as to the uses for which each is designed. This company has also published a four-page folder containing a list of their special tool making and production equipment, with a few illustrations of representative operations and productions.

ELECTRIC FURNACES.—Booklet 5-B, published by the Electric Furnace Company, Alliance, Ohio, is an attractive 24-page catalogue describing the Bailly types of electric furnaces for melting non-ferrous metals. These types embrace pusher type continuous furnaces for heating and annealing steel, copper, brass and aluminum, automatic control type continuous furnaces for heat treating steel castings and forgings, and car type furnaces for annealing steel, copper, brass and aluminum, and have electrical capacities of from 150 kw. to 1,500 kw., and furnace capacities of 1,000 lb. to 10 tons per hour. These furnaces are all of the resistance type and have several distinct features. The booklet contains illustrations of a number of actual installations and records of tests made with the equipment in several industrial plants.

AUTOMATIC CUT-OFF VALVES.—The Lagonda Manufacturing Company, Springfield, Ohio, in catalogue S-2 describes the Lagonda automatic cut-off valves for power plants, which are designed to close automatically in case of an abnormal flow of steam in either direction through the valve. The booklet contains an account of tests made by the Department of Commerce of the United States to determine their reliability of operation and adaptability for different conditions. External dashpot valves for use when the flow of steam from boilers to the header is practically constant, and internal dashpot valves for installation where load conditions are unsteady are fully described, with illustrations showing sectional views of the various classes of valves. Lagonda non-return valves which close in case of tube rupture or an accident to the boiler are also covered in the catalogue, which contains 32 pages.

FUEL OIL.—This is the title of a 46-page booklet published by the Tidewater Oil Company, New York, which gives a brief survey of experiences of various users of fuel oil and gas oil, and is intended to be of service not only to non-technical executives and plant managers, but also to plant engineers. It contains many charts, diagrams and illustrations and is divided into 15 chapters. The following chapter headings will give some idea of its contents: Advantages of Fuel Oil over Coal; the Nature and Refining of Crude Oil; Greater Economy of Heavy over Light Fuel Oils; Results Obtained Where Fuel has been Changed from Coal to Oil; Installation, Burner and Furnace Requirements. Under the heading Estimating the Saving, Fuel Oil Vs. Coal, a formula is given for computing roughly the amount which a particular plant can afford to pay for oil as computed from the present price of coal firing.